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PARIS, J. A.

Crusade

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Edward M. Wood

April 3rd 1850

PHILOSOPHY IN SPORT.

VOL. I.

'Tis not enough that Greek and Roman page,
At stated hours, the sprightly boy engage ;
Ev'n in his pastimes he requires a friend,
To warn, and teach him safely to unbend ;
And levying thus, and with an easy sway,
A tax of profit from his very play,
T' impress a value, not to be eras'd,
On moments, squander'd else, and running all to waste.

COWPER's *Tirocinium*.

LONDON :
Printed by A. & R. Spottiswoode,
New-Street-Square.

PHILOSOPHY IN SPORT

MADE

SCIENCE IN EARNEST;

BEING

AN ATTEMPT TO ILLUSTRATE THE FIRST PRINCIPLES
OF NATURAL PHILOSOPHY

BY THE AID OF

POPULAR TOYS AND SPORTS.



IN THREE VOLUMES.

VOL. I.

LONDON:

PRINTED FOR

LONGMAN, REES, ORME, BROWN, AND GREEN,
PATERNOSTER-ROW.

1827.



PHILOSOPHY

1881

SCIENCE IN NATURE

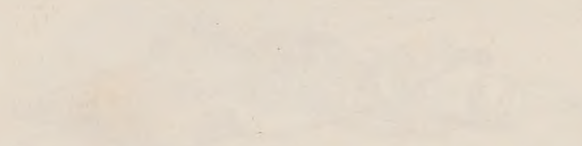
1881

ANALYSIS OF THE HISTORY OF THE HUMAN MIND

BY HENRY J. WELLS

LONDON

WELLS AND SONS



IN THE YEAR 1881

1881

LONDON

WELLS AND SONS

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1881

TO
MISS MARIA EDGEWORTH.

MADAM,

TO whom can a work, which professes to blend amusement with instruction, be dedicated with so much propriety, as to one, whose numerous writings have satisfactorily demonstrated the practicability and value of such a union; — to one, who has stripped Romance of her meretricious trappings, and converted her theatre into a temple worthy of Minerva? Justly has it been observed, that to the magic pens of Madame D'Arbly, and yourself, we are in-

debted for having the Novel restored to its consequence, and, therefore, to its usefulness; and I may be allowed to add, that your Harry and Lucy has shown how profitably, and agreeably, the machinery of fiction may be worked for the dissemination of truth.

That a life which has been so honourable to yourself, and so serviceable to the commonwealth, may be long extended, and deservedly enjoyed, is the fervent wish of

THE AUTHOR.

London,

TO THE READER.

TELL me, gentle Reader, whether thou hast not heard of the box of Pandora, which was no sooner opened by the unhappy Epimetheus, than it gave flight to a troop of malevolent spirits, which have ever since tormented the human race.—BEHOLD ! — I here present you with a magic casket, containing a GENIUS alone capable of counteracting their direful spells. Thou mayst, perhaps, say that its aspect but ill accords with the richness of its promised treasure ; so appeared the copper vessel found by the fisherman, as related in the Arabian tale ; but, remember, that no sooner had he broken its mystic seal, than the imprisoned genius spread itself over the ocean and raised its giant limbs above the clouds. But this was an evil and treacherous spirit ; mine is as benevolent as he is

mighty, and seeks communion with our race for no other object than to render mortals virtuous and happy. His name is—PHILOSOPHY. To be plain, for you must already, my young friends, have unriddled my allegory, in your progress through life, be not so vain as to believe that you will escape the evils with which its path is beset. Arm yourselves, therefore, with the talisman that can, at once, deprive adversity of its sting, and prosperity of its dangers ; for such, believe me, is the rare privilege of philosophy.

I must now take leave of you, for a short time, in order that I may address a few words to your parents and preceptors ; but, as I have no plot to abridge your liberties, or lengthen your hours of study, you may listen to my address without alarm, and to my plan without suspicion. Imagine not, however, that I shall recommend the dismissal of the cane, or the whip ; on the contrary, I shall insist upon them as necessary and indispensable instruments for

the accomplishment of my design. But the method of applying them will be changed ; with the one I shall construct the bow of the kite, with the other I shall spin the top.

The object of the present work is to inculcate that early love of science which can never be derived from the sterner productions. Youth is naturally addicted to amusement, and in this item his expenditure too often exceeds his allotted income. I have, therefore, taken the liberty to draw a draft upon Philosophy, with the full assurance that it will be gratefully repaid, with compound interest, ten years after date. But, to be serious ; those who superintend the education of youth should be apprized of the great importance of the first impressions. Rousseau has said, that the seeds of future vices or virtues are more frequently sown by the mother than the tutor ; thereby intimating, that the characters of men are often determined by the first impressions. There is much truth in this observation ; and those who do not com-

mence their study of nature at an early season, will afterwards have many unnecessary obstacles to encounter. The difficulty of comprehending the principles of Natural Philosophy frequently arises from their being at variance with those false ideas which early associations have impressed upon the mind ; the first years of study are, therefore, expended in *un*learning, and in clearing away the weeds, which would never have taken root in a properly cultivated soil. Writers on practical education have repeatedly enforced the advantages of the plan I am so anxious to advocate ; but, strange to say, it is only within a few years that any works have appeared at all calculated to afford the necessary assistance. In short, previous to the labours of Mrs. Marcet, the productions published for the purpose of juvenile instruction may be justly charged with the grossest errors ; and must have proved as destructive to the mind of the young reader, as the book presented by the physician Douban is said to have been to the body of the

Grecian king, who, as the Arabian tale relates, imbibed fresh poison as he turned over each leaf, until he fell lifeless in the presence of his courtiers : but these days have happily passed away, and the next generation will demonstrate the importance of the reformation.

Allow me, friendly Reader, before I conclude my address, to say a few words upon the plan and execution of the work before you. It is not intended to supersede or clash with any of the elementary treatises to which I have alluded ; indeed, its plan is so peculiar, that I apprehend such a charge cannot be brought against it. The author originally composed it for the exclusive use of his children, and would certainly never have consigned it to the press, but at the earnest solicitations of those friends upon whose judgment he places the utmost reliance.

It is scarcely necessary to offer any arguments in defence of the conversational plan of instruction ; the success of Mrs. Marcet's

dialogues has placed its value beyond dispute. It may, however, be observed that this species of composition may be executed in two different ways, either as direct conversation, where none but the speakers appear, which is the method used by Plato ; or as the recital of a conversation, where the author himself appears, and gives an account of what passed in discourse, which is the plan generally adopted by Cicero. The reader is aware, that Mrs. Marcet, in her “ Conversations on Philosophy,” has adopted the former, while Miss Edgeworth, in her “ Harry and Lucy,” has preferred the latter method. In composing the present work I have followed the plan of the last-mentioned authoress. Its advantages over the more direct conversational style appear to consist in allowing occasional remarks, which come more aptly from the author than from any of the characters engaged in the dialogue.

If scientific dialogues are less popular in our times than they were in ancient days, it must

be attributed to the frigid and insipid manner in which they have too frequently been executed; if we except the mere external forms of conversation, and that one character is made to speak, and the other to answer, they are altogether the same as if the author himself spoke throughout the whole, instead of amusing with a varied style of conversation, and with a display of consistent and well-supported characters. The introduction of a person of humour, to enliven the discourse, is sanctioned by the highest authority. Cæsar is thus introduced by Cicero, and Cynthio by Addison. In the introduction of Mr. Twaddleton, Major Snapwell, and Miss Ryland, I am well aware of the criticisms to which I have exposed myself; I have exercised my fancy with a freedom and latitude, for which, probably, there is not any precedent in a scientific work. I have even ventured so far to deviate from the beaten track as to skirmish upon the frontiers of the Novelist, and to bring off captive some of the artillery of romance; but

if, by so doing, I have enhanced the interest of my work, and furthered the accomplishment of its object, let me entreat that mere novelty may not be urged to my disparagement. If it be argued that several of my comic representations are calculated, like seasoning, to stimulate the palate of the novel reader, rather than to nourish the minds of the younger class, for whom the work was written, I may, upon such a charge, at least, plead common usage; for does not the director of a juvenile fête courteously introduce a few piquant dishes, for the entertainment of those elder personages who may attend in the character of a chaperone? You, surely, cannot deny me the full benefit of such a precedent; and so, Gentle Reader, I bid thee—Farewell.

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PHILOSOPHY IN SPORT.

CHAPTER I.

TOM SEYMOUR'S ARRIVAL FROM SCHOOL.—DESCRIPTION OF OVERTON LODGE.—THE HOROLOGE OF FLORA.—A GEOLOGICAL TEMPLE.—A SKETCH OF THE PERSON AND CHARACTER OF THE REVEREND PETER TWADDLETON.—MR. SEYMOUR ENGAGES TO FURNISH HIS SON WITH ANY TOY, THE PHILOSOPHY OF WHICH HE IS ABLE TO EXPLAIN.

THE summer recess of Mr. Pearson's school was not more anxiously anticipated by the scholars than it was by the numerous family of Seymour, who, at the commencement of the year, had parted from a beloved son and brother for the first time. As the season of

relaxation approached, so did the inmates of Overton Lodge (for such was the name of Mr. Seymour's seat) betray increasing impatience for its arrival. The three elder sisters, Louisa, Fanny, and Rosa, had been engaged for several days in arranging the little study which their brother Tom had usually occupied. His books were carefully replaced on their shelves, and bunches of roses and jasmines, which the affectionate girls had culled from the finest trees in the garden, were tastefully dispersed through the apartment; the festoons of blue ribbons, with which they were entwined, at once announced themselves as the work of graceful hands, impelled by light hearts; and every flower might be said to reflect from its glowing petals the smiles with which it had been collected and arranged. At length the happy day arrived; a post-chaise drew up to the front gate, and Tom was once again folded in the arms of his affectionate and delighted parents. The little group surrounded their beloved brother, and welcomed his return with all the warmth and artlessness of juvenile sincerity. "Well," said Mr. Seymour, "if the improvement of your mind corresponds with that of

your looks, I shall, indeed, have reason to congratulate myself upon the choice of your school. But have you brought me any letter from Mr. Pearson?" "I have," replied Tom, who presented his father with a small packet, which contained the usual account of the half year's expenditure, and a note from his master, in which he had commented in high terms of commendation, not only upon Tom's general conduct, but upon the rapid progress which he had made in his classical studies.

"My dearest boy," exclaimed the delighted father, "I am more than repaid for the many anxious moments which I have passed on your account. I find that your conduct has met with the highest satisfaction from your master, and that your good-nature, generosity, and, above all, your strict adherence to truth, have ensured the love and esteem of your school-fellows." This gratifying report brought tears of joy into the eyes of Mrs. Seymour; Tom's cheek glowed with the feeling of conscious merit; and the sisters interchanged looks of mutual satisfaction. Can there be an incentive to industry and virtuous conduct so powerful as the exhilarating smiles of approbation which the

schoolboy receives from an affectionate parent? Tom would not have exchanged his feelings for all the world, and he internally vowed that he would never deviate from a course that had been productive of so much happiness.

“But, come,” exclaimed Mr. Seymour, “let us all retire into the library. I am sure that our dear boy will be glad of some refreshment after his journey.”

We shall here leave the family circle to the undisturbed enjoyment of their domestic banquet, and invite the reader to accompany us in a stroll about the grounds of this beautiful and secluded retreat.

We are amongst those who believe that the disposition and character of a family may be more easily discovered from the rural taste displayed in the grounds which surround their habitation, than by any examination of the prominences on their heads, or of the lineaments in their faces. The decline of an ancient race is not more vividly depicted by the desolation which reigns around the mansion, than is the peaceful and contented industry of the cottager by the well cultivated patch of land which adjoins his humble dwelling; and it was im-

possible to view the grounds of Overton Lodge, without pronouncing it to belong to a family of classic taste, and cultivated habits.

The house, which was in the Ionic style of architecture, was situated on the declivity of a hill, so that the verdant lawn which was spread before its southern front, after retaining its level for a short distance, gently sloped to the vale beneath, and was terminated by a luxuriant shrubbery, over which the eye commanded a range of fair enclosures, beautified by an irregularly undulating surface, and interspersed with rich masses of wood. The uniformity of the lawn was broken by occasional clumps of flowering shrubs, so artfully selected and arranged, as to afford all the varied charms of contrast; while, here and there, a lofty elm flung its gigantic arms over the sward beneath, and cast a deep shade which enabled the inhabitants of the lodge to enjoy the air, even during the heat of a meridian sun. The shrubbery, which occupied a considerable portion of the valley, stretched for some distance up the western part of the hill; and, could Shenstone have wandered through its winding paths and deep recesses, his favourite Leasowes might

have suffered from a comparison. Here were mingled shrubs of every varied dye; the elegant foliage of white and scarlet acacias was blended with the dark-green-leaved chesnut; and the stately branches of the oak were relieved by the gracefully pendulous boughs of the beech. At irregular intervals, the paths expanded into verdant glades, in each of which the bust of some departed poet or philosopher announced the genius to which they were severally consecrated. From a description of one or two of these sequestered spots, the reader will readily conceive the taste displayed in those upon which our limits will not allow us to dwell.

After winding, for some distance, through a path so closely interwoven with shrubs and trees, that scarcely a sunbeam could find admission, a gleam of light suddenly burst through the gloom, and displayed a beautiful marble figure, which had been sent from Italy, representing Flora in the act of being attired by Spring. It was placed in the centre of the expanse formed by the retiring trees, and at its base were flowering, at measured intervals, a variety of those plants to which Linnæus has given the name of *Equinoctial flowers*, since

they open and close at certain and exact hours of the day, and thus by proper arrangement constitute the HOROLOGE OF FLORA. (1)* It had been constructed, under the direction of her mother, by Louisa Seymour. The hour of the day, at which each plant opened, was represented by an appropriate figure of nicely trimmed box; and these, being arranged in a circle, not only fulfilled the duty, but exhibited the appearance of a clock.

From this retreat several winding paths traced their mazy way through the deep recesses of the wood; the wanderer quitted, for a while, the radiance of the azure sky, and was refreshed by the subdued light which every where pervaded the avenue, except where the hand of taste had, here and there, turned aside the boughs, and opened a vista to bring the village spire into view, or to gladden the sight by a rich prospect of the distant landscape. After having descended, for some way, the path, losing its inclined direction, proceeded on a level, and thus announced to the stranger his arrival at the bottom of the valley.

* These figures refer to the additional notes at the end of the work.

What a rich display of woodland scenery was suddenly presented to his view ! A rocky glen, in which large masses of sandstone were grouped with picturesque boldness, terminated the path, and formed an area wherein he might gaze on the mighty sylvan amphitheatre, which gradually rose to a towering height above him, and seemed to interpose an insuperable barrier between the solitude of this sequestered spot and the busy haunts of men. Not a sound assailed the ear, save the murmur of the summer breeze, as it swept the trembling foliage, or the brawling of a small mountain stream, which gushed from the rock, and, like an angry child, fretted and fumed as it encountered the obstacles that had been raised by its own impetuosity. This was the favourite retreat of Mr. Seymour, and he had dedicated it to the genius of geology ; here had he erected a temple to the memory of Werner, and every pillar and ornament bore testimony to the refined taste of its architect. It consisted of a dome, constructed of innumerable shells and coral-lines, and surmounted by a marble figure of Atlas, bearing the globe on his shoulders, upon which the name of WERNER was in-

scribed. The dome was supported by twelve pillars of so singular and beautiful a construction as to merit a particular description; the Corinthian capital of each was of Pentelican marble; the column consisted of a spiral of about six inches in breadth, which wound round a central shaft of not more than two inches in diameter; upon this spiral were placed specimens of various rocks, of such masses as to fill up the outline, and to present to the eye the appearance of a substantial and well proportioned pillar. These specimens were arranged in an order corresponding with their acknowledged geological relations; thus, the *Diluvial* productions occupied the higher compartments; the *Primitive* strata, the lower ones; and the *Secondary* and *Transition* series found an intermediate place. The tessellated floor presented the different varieties of marble, so artfully interspersed as to afford a most harmonious combination; the *Uni-coloured*, *variegated*, *Madreporic*, the *Lamachella*, *Cipolino*, and *Breccia* marbles, were each represented by a characteristic and well defined specimen. The alcoved ceiling was studded with *Rock Crystal*, calcareous *Stalactites*, and beautiful *Cal-*

cedonies. A group of figures in *basso rilievo* adorned the wall which enclosed about a third part of the interior of the temple, and its subject gave evidence of the Wernerian devotion of Mr. Seymour; for it represented a contest between Pluto and Neptune, in which the watery god was seen in the act of wresting the burning torch from the hand of his adversary, in order to quench it in the ocean. Mr. Seymour had studied in the school of Freyburg, under the auspices of its celebrated professor; and, like all the pupils of Werner, he pertinaciously maintained the aqueous origin of our strata. But let us return to the happy party at the Lodge, whom the reader will remember we left at their repast. This having been concluded, and all those various subjects discussed, and questions answered, which the schoolboy, who has ever felt the satisfaction of returning home for the holidays, will more easily conceive than we can describe, Tom enquired of his father, whether his old friend, Mr. Twaddleton, the vicar of Overton, was well, and in the village. “He is quite well,” replied Mr. Seymour, “and so anxious to see you, that he has paid several visits, during the morning, to en-

quire whether you had arrived. Depend upon it, that you will see him here early to-morrow."

"I hope I shall," said Tom, and in that wish the whole juvenile party concurred; for the vicar, notwithstanding his oddities, was the most affectionate creature in existence, and never was he more truly happy than when contributing to the innocent amusement of his little "*play-mates*," as he used to call Tom and his sisters.

It may be here necessary to present the reader with a short sketch of the character of a person, who will be hereafter found to perform a prominent part in the little drama of Overton Lodge.

The Rev. Peter Twaddleton, Master of Arts, and Fellow of the Society of Antiquaries, for we must introduce him in due form, was about fifty-two years of age, twenty of which he had spent at Cambridge, as a resident Fellow of Jesus College. He had not possessed the vicarage of Overton above eight or nine years; and, although its value never exceeded a hundred and eighty pounds a year, so limited were his wants, and so frugal his habits, that he generally contrived to save a considerable portion

of his income, in order that he might devote it to purposes of charity and benevolence : but his charity was not merely of the hand, but of the heart ; distress was unknown in his village ; he fed the hungry, nursed the sick, and cheered the unfortunate. His long collegiate residence had imparted to his mind several peculiar traits, and a certain stiffness of address and quaintness of manner which at once distinguish the recluse from the man of the world ; in short, as Shakspeare expresses it, “ *he was not hackneyed in the ways of men.*” His face was certainly the very reverse to every thing that could be considered “ good-looking,” and yet, when he smiled, there was an animation that redeemed the irregularity of his angular features ; so benevolent was the expression of his countenance, that it was impossible not to feel that sentiment of respect and admiration which the presence of a superior person is wont to inspire : but his superiority was rather that of the heart than of the head ; not that we would insinuate any deficiency in intellect, but that his moral excellencies were so transcendent as to throw into the shade all those mental qualities which he possessed in common with

the world. He entertained a singular aversion to the mathematics, a prejudice which we are inclined to refer to his disappointment in the senate-house; for, although he was what is termed at Cambridge a "*reading man*," after all his exertions he only succeeded in obtaining the "*wooden spoon*," an honour which devolves upon the last of the "*junior optimes*." Whether this arose from any defect in his *bump of numbers* we are really unable to state, never having had an opportunity of verifying our suspicions by a manual examination of his cranium. He was, however, well read in the classics, and so devoted to the works of Virgil that he never lost an opportunity of quoting his favourite poet; and it must be admitted, that, although these quotations so generally pervaded his conversation as to become irksome, they were often apposite, and sometimes even witty. He had a happy knack of applying passages in a sense of which the poet could never have dreamt, and yet so pertinently, that it really appeared as if they had been intended for the occasions on which they were cited; but notwithstanding the delight which he experienced in a *lusus verborum* in the Latin language, of such contra-

dictory materials was he composed, that his antipathy to an English pun was so extravagant as to be truly ridiculous. This peculiarity has been attributed, but we speak merely from common report, to a disgust which he contracted for this species of spurious wit, during his frequent intercourse with the Johnians, a race of students who have, from time immemorial, been identified with the most profligate class of punsters. Be this, however, as it may, we are inclined to believe that a person who resides much amongst those who are addicted to this *vice*, unless he quickly takes the infection, acquires a sort of constitutional insusceptibility, like nurses, who pass their lives in infected apartments with perfect safety and impunity. His favourite, and we might add his only pursuit, beyond the circle of his profession, was the study of antiquities. He was, as we have already stated, a Fellow of the Society of Antiquaries; had collected a very tolerable series of ancient coins, and possessed sufficient critical acumen to distinguish between Attic *æru*go, and the spurious *verdure* of the modern counterfeit. Often had he undertaken an expedition of a hundred miles to inspect the interior of an

ancient barrow, or to examine the mouldering fragments of some newly discovered monument; indeed, like the connoisseur in cheese, blue-mould and decay were the favourite objects of his taste, and the sure passports to his favour; for he despised all *living* testimony, but that of worms and maggots. A coin with the head of a *living* sovereign passed through his hands with as little resistance as water through a sieve, but he grasped the head of an Antonine or Otho with insatiable and relentless avarice. Mr. Twaddleton's figure exceeded the middle stature, and was so extremely slender as to give him the air and appearance of a very tall man. He was usually dressed in an oldfashioned suit of black cloth, consisting of a single-breasted coat, with a standing collar, and deep cuffs, and a flapped waistcoat; but so awkwardly did these vestments conform with the contour of his person, that we might have supposed them the production of those Laputan tailors who wrought by mathematical principles, and held in sovereign contempt the illiterate fashioners who deemed it necessary to measure the forms of their customers; although it was whispered by some of the loquacious spinsters in the vil-

lage that the aforesaid mathematical artists were better acquainted with the *angles* of the Seven Dials, than with the *squares* of the west end. They farther surmised that the vicar's annual journey to London, which in truth was undertaken with no other object than that of attending the Anniversary of the Society of Antiquaries, on Saint George's day, was for the laudable purpose of recruiting his wardrobe. If the coat, with its straggling and disproportioned suburbs, possessed an amplitude of dimensions which ill accorded with the slender wants of his person, this misapplied liberality was more than compensated by the rigid economy exhibited in the *nether* part of his costume, which evidently had not been designed by a contemporary architect; that vestment which is never alluded to in polished society but through the medium of ingenious circumlocution, stuck as closely to the part it was destined to protect, and as faithfully represented it, as the most zealous member ever adhered to the interests of an independent borough. Not so his shoes, which, for the accommodation of those unwelcome parasites, vulgarly called *corns*, were constructed in the form of a battledore, and dis-

played such an unbecoming quantity of leather, that, as Ned Hopkins, a subaltern wit of the village ale-house, observed, “however economical their parson might appear, he was undoubtedly *supported in extravagance*.” In a village like Overton, where there resided no less than seven discontented old maids, this joke against the vicar’s *understanding* was not likely to be lost; nor did the natural association between tithes and “*corn-bags*” escape the observation of Hopkins, but was repeated with various other allusions of equal piquancy, to the no small annoyance of the reverend gentleman, and, as he declared, to the disparagement of his cloth. And it may be here observed, that the aforesaid vestals had long proclaimed open rebellion against their worthy priest; his manners, they asserted, were coarse and vulgar, his habits morose and unsociable, and his sermons mere chip and porridge: but the true cause of this inveteracy sprang from a deeper and more secret source; he had inveighed, in terms of bitter sarcasm, against the uncharitable practice of backbiting; his liberality was considered as a reflection upon their penuriousness; and his merited popularity in the village, as a detrac-

tion from their own assumed consequence. Miss Kitty Ryland had, moreover, if Fame spoke the truth, a still more powerful motive for her hatred, *Spretæ injuria formæ*,* as Mr. Twadleton would have doubtless expressed it, had he ever alluded to the affair, but to his credit be it recorded, that he was never heard to throw out the slightest insinuation upon the subject. Nor did he condescend to notice, nor, indeed, appear conscious of the meaning of the various innuendos, in which Mr. Seymour, with his accustomed pleasantry, would frequently indulge. On one of these occasions he placed a tall cruet of sugar before the vicar, observing, that it looked *very sweet* at the squat *vinegar* bottle that stood near it. It was admitted by those who were acquainted with the personages, thus represented, that the similitude, as far as it went, was perfect. The worthy vicar was, in truth, a tall casket, brimful of every thing that was sweet; and it must be acknowledged, that Miss Kitty, who was a little squat figure, might with equal propriety be said to contain no small quantity of *acid*, which her age had not

* "The injury of a rejected suit." *Æn.* i. 51.

mellowed. The vicar, however, appeared insensible to the joke, although Mrs. Seymour maintained that this expressive pantomime was not lost upon him, for she had observed a cloud pass over his brow, as he hastily pushed away the sugar, and substituted the pepper castor in its place. We are inclined to coincide with Mrs. Seymour in her opinion ; and, if the affair has been correctly reported, it will add much probability to the conjecture ; for, it is said, that, upon some conference of the vicar with Miss Kitty, the artless lady misconstrued a passing expression of friendly kindness into a declaration of a more tender nature, and accordingly breathed in soft accents her ready compliance, which so astonished, offended, and incensed our hero, that his indications of indignation amounted to something very like fury ; and the squat *vinegar bottle* found, to her dismay, that she had been ogling a castor which contained pepper instead of sugar. But let us return to our party.

After the evening repast had been concluded, Tom proposed a ramble through the shrubbery. He was anxious to revisit the scene of his former sports ; and Louisa readily met his wishes, for

she was also desirous of showing him the *botanical clock*, which had been planned and completed since his absence. Mr. Seymour accompanied his children, and as they walked across the lawn, Tom asked his papa whether he remembered the promise he had made him on quitting home for school, that of furnishing him with some new amusements during the holidays.

“ I perfectly remember,” said his father, “ the promise to which you allude, and I hope that you equally well recollect the conditions with which it was coupled. When your mamma gave you a copy of Mrs. Marcet’s instructive Dialogues on Natural Philosophy, I told you that, after you had studied the principles which that work so admirably explains, you would have but little difficulty in understanding the philosophy of toys, or the manner in which each produced its amusing effects ; and that, when the midsummer holidays commenced, I would successively supply you with a new amusement, whenever you could satisfactorily explain the principles of those you already possessed. “ Was not that our contract ? ”

“ It was,” exclaimed Tom, with great eagerness, “ and I am sure I shall win the prize,

whenever you will put my skill to a trial; at which I hope my mamma and sisters will be present."

"Certainly," replied Mr. Seymour, "and I trust that Louisa and Fanny, who are of an age to understand the subject, will not prove uninterested spectators. Little John, too, will profit by our scheme; for, as I shall necessarily require, for illustration, certain toys which can scarcely afford any amusement to a boy of your age and acquirements, it is but fair that they should be transferred into his hands."

"Thank you! thank you! dear papa," was simultaneously shouted by several voices, and the happy children looked forward to the morrow, with that mixed sensation of impatience and delight which always attends juvenile anticipations.



CHAP. II.

MR. TWADDLETON'S ARRIVAL, AND RECEPTION. —
HIS REMONSTRANCES AGAINST THE DIFFUSION OF
SCIENCE AMONGST THE VILLAGE MECHANICS. —
A DIALOGUE BETWEEN MR. SEYMOUR AND THE
VICAR, WHICH SOME WILL DISLIKE, MANY AP-
PROVE OF, AND ALL LAUGH AT. — THE PLAN OF
TEACHING PHILOSOPHY, BY THE AID OF TOYS,

DEVELOPED AND DISCUSSED. — MR. TWADDLETON'S OBJECTIONS ANSWERED. — HE RELENTS, AND ENGAGES TO FURNISH AN ANTIQUARIAN HISTORY OF THE VARIOUS TOYS, AND SPORTS.

THE apartment, in which Mrs. Seymour and her daughters usually pursued their morning avocations, opened upon the lawn already described; Mr. Seymour's library window was at the eastern side of the house, and commanded a more extensive prospect. On the turf before the windows, while his mother and elder sisters were occupied in their morning-room, Tom, with his little playfellow, Rosa, who was a year younger than himself, were running races, or playing at ball; but, every now and then, Tom could not help thinking of papa, and his promise; and he would lead Rosa to the other side of the lawn to steal a peep into the library, in the hope of finding that his papa was preparing to quit it. After many an anxious peep, he at length had the satisfaction of seeing him throw aside his papers, and take up his hat; at this signal, they both set up a shout of triumph that would have astonished the female party, had they not immediately discovered its meaning by the repeated cry of, "Papa is

coming! papa is coming!" Works, books, and drawings were quickly laid aside, and all were prepared to share in the anxiously expected pleasure.

"Tom," said Mr. Seymour, as he advanced towards his family, who had by this time assembled on the lawn, "I have not forgotten my engagement, and am now prepared to devote the rest of the morning to its fulfilment." At this moment the servant advanced, and announced the arrival of Mr. Twaddleton; Tom and his sisters immediately ran forward to meet him.

"My dear boy," exclaimed the vicar, "I am truly rejoiced to see you;—when did you arrive from school?—How goes on Virgil?—Hey, my boy?—You must be delighted with the great Mantuan bard;—now confess, you little Trojan, can you eat a cheesecake without being reminded of the Harpy's prophecy, and its fulfilment, as discovered by young Ascanius:—

'Heus! etiam *mensas* consumimus, inquit Iulus.'*

* ———. "The hungry band
Invade their trenchers next, and soon devour,
To mend the scanty meal, their cakes of flour.
Ascanius this observed, and smiling said,
'See! we devour the *plates* on which we fed.'"

Æn. vii. 116.

“But, bless me, how amazingly you have grown! and how healthy you look!” Tom took advantage of this pause in the vicar’s address, which had hitherto flowed in so uninterrupted and rapid a stream as to have precluded the possibility of any reply to his questions, to inform him that his papa was on the lawn, and desirous of seeing him.

“Mr. Twaddleton,” exclaimed Mr. Seymour, “you are just in time to witness the commencement of a series of amusements, which I have proposed for Tom’s instruction during the holidays.”

“Amusement and instruction,” replied the vicar, “are not synonymous in my vocabulary; unless, indeed, they be applied to the glorious works of Virgil; but let me hear your scheme.”

“I have long thought,” said Mr. Seymour, “that all the first principles of natural philosophy might be easily taught, and beautifully illustrated, by the common toys which have been invented for the amusement of youth.”

“A fig for your philosophy,” was the unceremonious and chilling reply of the vicar. “What have boys,” continued he, “to do with

philosophy? Let them learn their grammar, scan their hexameters, and construe Virgil; it is time enough to inflict upon them mathematical torments when their names are entered on the University boards."

"I differ from you entirely, my worthy friend, the principles of natural philosophy cannot be too early inculcated, nor can they be too widely diffused. Classical learning is, undoubtedly, essential to the polished gentleman; but science is the staff upon which he must rely for support."

"Hoity toity!" exclaimed the reverend gentleman, "such principles accord not with my creed; heresy, downright heresy; that a man of your excellent sense and intelligence can be so far deceived! But the world has run mad, and much do I grieve to find, that the seclusion of Overton Lodge has not secured its inmates from the infection. I came here, Mr. Seymour, to receive your sympathy, but, alas! how can I expect consolation from one who entertains such hostile opinions."

"You astonish me, what can have happened?" cried Mr. Seymour.

“The maiden ladies of Overton, my dear sir, have imposed a charge upon their consciences, for which years of penitence would scarcely atone. There is Tom Plank, the carpenter, under the auspices of Miss Kitty Ryland, *Dux fœmina facti**, as Virgil has it, soliciting subscriptions for the establishment of a philosophical society. I understand that this mania, for by what other, or more charitable term can I express such conduct? has seized this deluded man since his return from London, where he unfortunately became acquainted with some of the members of the *Mechanics’ Institute*, who have succeeded in persuading him that all the “hewers of wood, and drawers of water,” are about to associate themselves into societies for the promotion of science. Preposterous idea! as if a block of wood could not be split without a knowledge of the doctrine of percussion, nor a pail of water drawn from the well, without an acquaintance with hydrostatics; Miss Kitty Ryland, and her *adjective*, Miss Margery Noodleton, have eagerly counte-

* “A woman leads the way.” *Æn.* i. 368.

nanced the plan, for no other purpose, as I verily believe, than that of vexing me; *Furor arma ministrat**, as Virgil has it; but, as I am a Christian priest, I solemnly declare, that I grieve only for my flock, and raise my feeble voice for no other purpose than that of scaring the wolf from the fold: to be angry, as Pope says, would be to revenge the faults of others upon ourselves; but I am not angry, Mr. Seymour, I am vexed, sorely vexed."

"Take it not thus to heart, my dear vicar," replied his consoling friend; "the abuse of science may certainly prove injurious, but its sober and well-timed application cannot fail to increase the happiness of every class of mankind, as well as to advance and improve every branch of the mechanical arts; so thoroughly am I satisfied upon this point, that I shall subscribe to the proposed society with infinite satisfaction."

"Mr. Seymour! Mr. Seymour! you know not what you do. Would you scatter the seeds of insubordination? manure the weeds of infidelity? fabricate a battering-ram to demolish

* "Fury supplies the weapons." *Æn.* i. 154.

our holy church? Such, indeed, must be the effect of your Utopian scheme, for, as Virgil has it,

‘ In nostros fabricata est machina muros.’*

“ Come, come, my good friend, this is declamation without argument.”

“ Without argument! Many are the sad instances which I could adduce in proof of the evil effects which have already accrued from the introduction of this system. I am not in the habit, sir, of dealing in empty assertion; already has the aforesaid Tom Plank ventured to question the classical knowledge of his spiritual pastor, and, as I understand, has declared himself publicly, at the club, as my rival in antiquarian pursuits.”

“ And why should he not,” said the mischievous Mr. Seymour; “ I warrant you he already possesses many an *old saw*; ay, and of a very great age too, if we may judge from the *loss of its teeth*.”

Allow us, gentle reader, to enquire, whether thou hast ever observed the quivering back of a horse, when goaded by the sting of a gad-fly? If so, you

* “ An engine ’s raised to batter down our walls.”

Æn. ii. 46.

will readily conceive the convulsive motion produced in the vicar's frame, when assailed by a pun. Such was the effect on the present occasion; and no sooner did the amiable Mrs. Seymour observe it, than she uttered the following remonstrance: — “ My dear husband, pray spare the feelings of our friend; you well know how morbidly sensitive he is to a pun, and it is scarcely fair, under the present circumstances, to exercise your ingenious art of tormenting with such unmerciful assiduity.”

“ Let me alone,” replied Mr. Seymour, in a half-whisper, “ it is the only way to subdue that unfortunate prejudice.” Mrs. Seymour here observed, that Addison would denominate such a system “ *arguing by torture*,” but, added she, “ I really think that the rack is a species of syllogism which ought to be laid aside with other popish refinements.”

“ You strangely mistake the matter,” said Mr. Seymour: “ depend upon it that it does not inflict any substantial suffering upon the vicar; he has so long accustomed himself to reject a pun with disdain, that what at first he did from impulse, or perhaps pedantry, he continues from habit. I verily believe, that the pride which he has

taught himself to feel upon these occasions, converts what you regard as pain into a feeling of satisfaction, for never is he so lively as when a few puns have been discharged in his presence; like the over-shot wheel, which rejects the stream as useless foam, but not until it has acquired motion and activity from its momentum."

During this conjugal altercation, Mr. Twad-dleton had been occupied in whirling round his steel watch-chain with inconceivable rapidity, and, after a short pause, he burst out into the following exclamation:—

"Worthy sir! if you persist in asserting, that a man whose occupation is to *plane deal boards*, and who is incapable of uttering a single sentence, without the grossest display of bad grammar, is prepared to dive into the sacred mysteries of antiquity, I shall next expect to hear that"—

"A truce, a truce," cried Mr. Seymour, interrupting the vicar, "to all those hackneyed objections; and let us *deal plainly* with your *planer* of *deals*; you assert that the carpenter cannot speak grammatically, and yet he gains his livelihood by *mending stiles*; you complain of his presumption in argument, would it not be a

desertion of his *post* to decline *railing*? and then, again, with respect to his antiquarian pretensions, compare them with your own; *you rescue saws from the dust, he obtains dust from his saws.*"

"What madness has seized my unfortunate friend? or, as Virgil has it, —

‘Infelix! quæ tanta animum dementia cepit?’*

But let it pass, let it pass, Mr. Seymour; my profession has taught me to bear with humility and patience the contempt and revilings of my brethren; I forgive Tom Plank for his presumption, as in that case I alone am the sufferer; but I say to you, that envy, trouble, discontent, strife, and poverty will be the fruits of the seeds you would scatter. I verily believe, that unless this ‘march of intellect,’ as it has been termed, is speedily checked, Overton, in less than twelve months, will become a deserted village; for there is scarcely a tradesman who is not already distracted by some visionary scheme of scientific improvement, that leads to the neglect of their occupations, and the dissipation of the honest

* “What fury’s seized my friend?” *Æn.* v. 465.

earnings which their more prudent fathers had accumulated; ‘*Meliora pii docuere parentes.*’* as the Poet has it. What think you of Sam Tickle, the watchmaker, who has suffered the parish-clock to stand still for the last ten days, so absorbed has been his attention, in attempting to illuminate a *sun*-dial, by gas, in order that it may tell the hour during the absence of the sun?”

“What think I?” said Mr. Seymour; “why that he is *in pursuit of a shadow.*”

“Then, again,” continued the vicar, “there is Will Snaffle, the saddler, so beside himself, as to relinquish business, shut up shop, and proceed to London, to take out a patent for his new invention to sail against the wind. What think you of that, Mr. Seymour?”

“I think he had better exert his inventive faculty in contriving a saddle that will go without a horse.”

“That,” said the vicar, “it would appear he has left to the genius of his partner; for I must inform you that he has entered into a safe and provident contract with Doctor Doseall.

* “Their pious sires a better lesson taught.”

our village Æsculapius, by which it is agreed that the said doctor is to provide the *purse*, and Will Snaffle the *brains*, that may be requisite for carrying into effect the scheme of sailing against the wind, the profits of which are to be equally divided between them."

"Let Snaffle alone," cried Mr. Seymour, "he well knows how to *put the saddle on the right horse*. The parties, however, are well matched, and if they accomplish their plan I am sure it must be by means of a *vacuum*, to which the *head* of the one, and the *pocket* of the other have equal pretensions. But I am anxious to hear something about the doctor's invention of propelling a saddle without a horse."

"Presently, presently," cried the vicar; "but I must first give you some account of an extraordinary scene that occurred in our village yesterday, and which threw all its inhabitants into the utmost consternation. I had just concluded the funeral service, and was quitting the churchyard, reflecting on the extraordinary increase of mortality since the arrival of Doseall's Brummagem diploma, for which I understand he actually paid 11*l.* 10*s.* sterling, when on

casting my eyes up Pigmore Lane, I beheld, as I thought, the figure of a dragon approaching, with flames of fire issuing from its head, and a troop of dogs yelling and barking at its heels. It yielded at the same time a sound so jarring and discordant, that a cockney concert of marrow-bones and cleavers would have been soft music in comparison with it. As it drew nearer, I discovered the figure of the village doctor, mounted on its back, and shrouded in vapours, which my imagination whispered could be no other than the pestilential effluvia from the nostrils of this unknown, but hideous monster. By the time it had arrived within fifty feet of the spot on which I was standing, so dense was the atmosphere around it, that my fancy was taxed to complete the figure from the imperfect outline that was visible. While thus agitated by the variety, as well as novelty, of my sensations, guess, if you can, my horror and surprise, when in a moment, in the twinkling of an eye, the mysterious monster before me exploded with a report that made the very ground beneath me tremble like an aspin leaf; a volume of smoke curled in dingy wreaths around the spot, and a shower of large shot

came pouring down, like hail, in all directions ; at the same moment, a thunderbolt whizzed past my ear, dashed through the window of the china-shop, and committed, as I have since learned, more damage amongst a certain class of crockery, than I, the historian of the event, feel it necessary, or decent, to record. This terrible explosion was followed by a profound repose ; even the dogs, that had pursued it with such ceaseless vociferation, had been awed into silence. In a few moments, my fears, as well as the fumes of the explosion, had cleared off, and I advanced and found poor Doseall struggling in a heap of mud, like a fly in one of his own electuaries, although, it must be confessed, that it resembled any thing more than an electuary of *roses*. ‘What means all this?’ exclaimed I, in a tone of alarm mingled with that of astonishment. ‘Oh ! this odious science,’ cried a sepulchral voice, which I immediately recognised to be that of Ralph Spindle, journeyman and compounder of the prostrate doctor. ‘Spindle, Spindle,’ murmured his unfortunate master, as he removed the *black dose* from his mouth, that had hitherto rendered his voice inarticulate, ‘did I not caution thee,

thou scum of the profession; did I not tell thee to fill the lamp with rectified spirit? and, dun-derhead as thou art, thou hast wasted my æther, and blown up the body, as well as the reputation of thy master and patron.' As he uttered these words, he exhibited a countenance at which I verily believe a monk of La Trappe would have relaxed his iron features; never, surely, since the days of Nisus, had the *human face divine* suffered so gross an indignity."

"And you laughed?" said Mr. Seymour.

"I confess it," replied the vicar, "and did not Æneas laugh upon a similar occasion? or, as Virgil has it, —

'Et simul his dictis, faciem ostendebat, et udo
Turpia membra fimo — *risit* pater optimus olli.'"*

The vicar proceeded : —

"‘Mr. Twaddleton,’ said the doctor, addressing me in a tone of deep despair, which converted my smile into an expression of commiseration, ‘never was there an invention more happily conceived, more successfully executed, nor more provokingly ruined. The steam carriage, or velocipede, whose remnants lie at your

* Æn. v. 357.

feet, was constructed for the purpose of conveying me to visit my patients; and since the value of every engine consists in its power of economising time and expense, I contrived to make the lamp, necessary for producing the steam, boil my decoctions, and the wheels, by which I was to be propelled forward, to perform the duties of my laboratory, and thus to supersede the services of that *extract* of ignorance and stupidity, Ralph Spindle, to whose blunders I am indebted for my present misfortunes. One of the wheels, as you may perceive, actuated my pestle and mortar, and the other rolled a machine to round my pills.' I now discovered that the flame which I had witnessed, upon its first appearance, was that of the spirit lamp; that the shower of bullets which had accompanied its explosion consisted of pills, and that the thunderbolt was no other than the pestle, which had taken advantage of the general confusion, to bolt from its lazy and sleeping partner, the mortar, with whom it had so long incessantly laboured in good fellowship, for the benefit of Doseall and suffering humanity."

"An admirable thought upon my word," said Mr. Seymour; "and so the wheels which

were employed in *carrying on* their master, were, at the same time, *revolving* schemes for *carrying off* his patients; but it appears that the visions of our knight of the pestle have vanished in smoke."

"By no means," replied the vicar, "his lamp, but not his hopes, has been extinguished; his carriage, but not his patience, has been wrecked. Depend upon it that, in a few days, we shall see him astride his hobby, surrounded by rattletraps, which the vulgar and ignorant may, perhaps, regard as more befitting the tinker of kettles, than the cobbler of constitutions."

"Upon my word," said Mr. Seymour, "your report of this affair is exquisitely humorous; and its publication would go farther towards repressing the present prevailing, or, as you call it, Utopian system of scientific education, than the most profound and argumentative oration;—

'For ridicule shall frequently prevail,
And cut the knot when graver reasons fail.'"

"If I thought so," exclaimed the vicar, "I would willingly—but no, no, it would ill become a village priest to turn a knight-errant."

“ It would, at all events,” continued Mr. Seymour, “ strengthen the cause which I so warmly advocate, of extending the knowledge of Natural Philosophy amongst the higher classes ; in short, it has now become essential to their very existence, and to the maintenance of their rank in the scale of society. If the ground be so watered and manured, as to raise up Will o’ the wisps, it behoves every inhabitant to provide himself with a light that may enable him to avoid their treacherous glare.”

The vicar, after this digression, proceeded in his lamentations :—“ Old Roger Naylor, the blacksmith, has been foolish enough to desert his forge, and open a school for elementary instruction ; what say you to that, Mr. Seymour ?”

“ That it is less to be condemned than the conduct of Snaffle ; since *he*, at least, still continues in the same line of business.”

“ I suppose,” observed Mrs. Seymour, jocosely, “ that writing and *forging* have formed a natural association in your mind, ever since the conviction of poor Charles Scribe.”

“ That is very well said,” exclaimed Mr. Twaddleton ; “ upon my word, madam, it is the

first pun I ever heard in my life with pleasure. Depend upon it, Mrs. Seymour, no good can ever arise from this village education."

"Softly, I prithee, Mr. vicar," said Mr. Seymour, "and remember that if I commit another pun, you may thank yourself for the provocation. This said blacksmith, as you state, has opened a seminary for *elementary* instruction; now, I only maintain, that a person, who has been enabled, for the last thirty years, to procure a respectable subsistence for himself and family, by means of the *elements*, cannot be accused of deserting his calling, by becoming the master of an *elementary* establishment."

Tom, who had been attentively listening to this discourse, was quite unable to comprehend what *elements* had to do with the shoeing a horse; the vicar was equally at a loss to discover the speaker's meaning; for, as he said, he could not possibly imagine what affinity existed between the *heels* of a quadruped, and the *head* of a child.

"Except," observed Mrs. Seymour, "that, in both cases, it is the business of the artist to hammer something soundly into them."

"That is a happy *hit* of yours," said Mr.

Seymour, “but you have, nevertheless, not *hit the right nail on the head*. I must, therefore, afford you an explanation. Are not *fire, water, earth, and air, the elements?* and has not the *air* animated his bellows, the *fire* heated his iron, the *water* tempered his work, and the *earth* afforded him moulds for his castings?”

Mrs. Seymour here observed, that this reminded her of an enigma that she had once heard, and which, at the request of Louisa, she repeated as follows : —

“A shoemaker once made shoes without leather,
With all the four elements joined together;
There were Fire and Water, and Earth too, and Air,
And most of his customers wanted two pair.”

“Well, vicar,” said Mr. Seymour, “have I not made out my position?”

“Pshaw! there is no end to your equivoques,” uttered the indignant and persecuted clergyman; “they are ever perverting reason, and stifling argument; like weeds in a crop of corn, they usurp the soil, and disappoint the hopes of the husbandman; or, as Virgil has it, —

‘Infelix lolium, et steriles dominantur avenæ.’ *

* “And towering weeds malignant shadows yield.”

Georg. i. 154.

But it is in vain to complain, although I must confess that my patience has met with many severe trials; and, as if to crown the whole of my mortifications, there is my faithful clerk, Jerry Styles, so elated with the prospect of becoming learned, that I do assure you, he already begins to criticise my sermons, and supports his arguments with such pertinacity, that he always contrives to have the last word."

"The *last word*," repeated Mr. Seymour, "well, that again is all in the way of business; is it not his duty to cry AMEN?"

"Mr. Seymour, we will, if you please, terminate our discourse; I perceive that you are determined to meet my remonstrances with ridicule; when I had hoped to bring an argument incapable of refutation, *Tum variæ illudunt pestes**, as Virgil has it."

"Pray, allow me to ask," said Mr. Seymour, "whether my puns, or your quotations, are best entitled to be regarded as *pestes*? Now, hear me; I will readily enter into a convention, — do you leave off quoting Virgil, and I will cease to pun: but, remember, that whenever

* "Then sundry pests arise to mock our pains."

Georg. i. 181.

you commit a breach of our agreement, you shall be visited by its appropriate *punishment*."

"That you should compare the vile practice of punning with the elegant and refined habit of conveying our ideas by classic symbols, does indeed surprise and disturb me. Pope has said that words are the counters by which men represent their thoughts; the plebeian," continued the vicar, "selects base metal for their construction, while the scholar forms them of gold and gems, dug from the richest mines of antiquity. But to what vile purposes does the punster prostitute such counters? Not for the interchange of ideas, but, like the juggler, to deceive and astonish by acts of legerdemain."

Mr. Seymour asked the vicar whether he consented to his proposition.

"Cheerfully, most cheerfully," was the ready reply of the vicar.

"Having then settled these preliminaries," continued Mr. Seymour, "I hope I may bring you to view, with somewhat more complacency, my favourite project of teaching philosophy by the aid of toys and sports."

"Mr. Seymour, the proposal of instructing children in the principles of natural philosophy,

is really too visionary to require calm discussion; and can be equalled only in absurdity by the method which you propose to carry it into effect."

"My good sir," replied Mr. Seymour, "as you do not lose any opportunity to turn philosophy into ridicule, it is not likely that we should, at present, agree upon these subjects; —

' With men, like thee, how can I form alliance?

You, science turn to sport, *I*, sport to science.'

"Indulge me, however, so far as to listen to the plan, by which it is my intention to turn sport into science, or, in other words, toys into instruments of philosophical instruction."

"And is it then possible," said the vicar, in a tone of supplication, "that you can seriously entertain so wild, and, I might even add, so cruel a scheme? Would you pursue the luckless little urchin from the schoolroom into the very playground, with your unrelenting tyranny? a sanctuary which the most rigid pedagogue has hitherto held inviolable. Is the buoyant spirit so forcibly, though perhaps necessarily, repressed, during the hours of discipline, to have no interval for its free and uncontrolled expansion? Your science, methinks, Mr. Seymour, might

have taught you a wiser lesson; for you must well know that the most elastic body will lose its resilient property if it be constantly kept in a state of tension."

"A fine specimen of sophistry, upon my word," cried Mr. Seymour, "and would, doubtless, raise every nursery-governess and doating grandmother in open rebellion against me; but, let me add, that it ill becomes a man of liberal and enlarged ideas, to suffer his opinions to be the sport of mere words; for, that our present difference is an affair of words, and of words only, I will undertake to prove, to the satisfaction of any unprejudiced person. *Play* and *work* — *amusement* and *instruction* — *toys* and *tasks* — are invariably but most unjustifiably employed as words of contrast and opposition; an error which has arisen from the indistinct and very indefinite ideas which we attach to such words. If the degree of mental exertion be said to constitute the difference between *play* and *work*, I am quite sure that the definition would be violated in the first illustration; for let me ask, when do boys exert so much thought as in carrying into effect their holiday schemes? The distinction may, perhaps, be made to turn upon the

irksome feelings which might be supposed to attend the drudgery of study; but the human mind, whether in youth or manhood, is ever gratified by the acquisition of information; every occupation soon cloy, unless it be seasoned by this stimulant. Is not the child idle and miserable in a nursery full of playthings, and to what expedient does he instinctively fly to relieve his *ennui*? Why, he breaks his toys to pieces, as Miss Edgeworth justly observes, not from the love of mischief, but from the hatred of idleness, or rather from an innate thirst after knowledge; and he becomes, as it were, an enterprising adventurer, and opens for himself a new source of pleasure and amusement, in exploring the mechanism of their several parts. Think you, then, Mr. Twaddleton, that any assistance which might be offered the boy, under such circumstances, would be received by him as a task? Certainly not. The acquisition of knowledge then, instead of detracting from, must heighten the amusement of toys, and, if I have succeeded in convincing you of this truth, my object is accomplished."

Thus did Mr. Seymour, like an able general, assail his adversary on his own ground; he

drove him, as it were, into a corner, and by seizing the only pass through which he could make his escape, forced him to surrender at discretion.

“Why, truly,” replied the vicar, after a short pause, “I am ready to admit that there is much good sense in your observations; and, if the scientific instruction upon these occasions be not carried so far as to puzzle the boy, I am inclined to coincide with you.”

“Therein lies the whole secret,” said Mr. Seymour, “when an occupation agreeably interests the understanding, imagination, or passions of children, it is what is commonly understood by the term *play* or *sport*; whereas, that which is not accompanied with such associations, and yet may be necessary for their future welfare is, properly enough, designated as a *task*.”

“I like the distinction,” observed the vicar.

“Then may I hope that you will indulge me so far as to listen to the scheme, by which it is my intention to turn ‘Sport into Science,’ or, in other words, *Toys* into instruments of *Philosophical Instruction*?”

The vicar nodded assent.

Mr. Seymour proceeded. — “In the first

place, I would give the boy some general notions with regard to the properties of matter, such as its gravitation, vis inertiae, elasticity, &c. What apparatus can be required for such a purpose, beyond some of the more simple toys? Indeed, I will undertake to demonstrate the three grand laws of motion by a game at ball; while the composition and resolution of forces may be beautifully exemplified during a game of marbles, especially that of “ring-taw:” but in order that you may more clearly comprehend the capability of my plan, allow me to enumerate the various philosophical principles which are involved in the operation of the several more popular toys and sports. We will commence with the ball; which will illustrate the nature and phenomena of *elasticity*, as it leaps from the ground; — of *rotatory motion*, while it runs along its surface; — of *reflected motion*, and of the *angles of incidence and reflection*, as it rebounds from the wall; — and of *projectiles*, as it is whirled through the air: at the same time the cricket-bat may serve to explain the *centre of percussion*. A game at marbles may be made subservient to the same purposes, and will farther assist us in conveying clear

ideas upon the subject of the *collision of elastic and non-elastic bodies*, and of their *velocities and direction after impact*. The *composition and resolution of forces* may be explained at the same time. The nature of *elastic springs* will require no other apparatus for its elucidation than the numerous leaping frogs and cats with which the nursery abounds. The leathern sucker will exemplify the nature of *cohesion*, and the effect of water in filling up those inequalities by which contiguous surfaces are deprived of their attractive power; it will, at the same time, demonstrate the nature of a *vacuum*, and the influence of *atmospheric pressure*. The squirt will afford a farther illustration of the same views, and will furnish a practical proof of the weight of the atmosphere in raising a column of water. The theory of the pump will necessarily follow. The various balancing toys will elucidate the nature of the *centre of gravity*, *point of suspension*, and *line of direction*: the see-saw, rocking-horse, and the operation of walking on stilts, will here come in aid of our explanations. The sling will demonstrate the existence and effect of *centrifugal force*; the top and tetotum will prove the power of vertiginous motion to sup-

port the axis of a body in an upright position. The trundling of the hoop will accomplish the same object. The game of *bilboquet*, or cup and ball, will show the influence of rotatory motion in steadying the rectilinear path of a spherical body, whence the theory of the rifle gun may be deduced. For conveying some elementary ideas of the doctrine of *oscillation*, there is the swing. The flight of the arrow will not only elucidate the principles of *projectiles*, but will explain the force of the air in producing rotatory motion by its impact on oblique surfaces: the revolution of the shuttlecock may be shown to depend upon the same resolution of forces. Then comes the kite, one of the most instructive and amusing of all the pastimes of youth: its ascent at once develops the theory of the composition and resolution of forces, and explains various subordinate principles, which I shall endeavour to describe when we arrive at the subject. The theory of colours may be pointed out to the boy as he blows his soap-bubbles; an amusement which will, at the same time, convince him that the air must exert a pressure equally in all directions. For explaining the theory of sound,

there are the whistle, the humming-top, the whiz-gig, the pop-gun, the bull-roarer, and sundry other amusements well known in the play-ground ; but it is not my intention, at present, to enumerate *all* the toys which may be rendered capable of affording philosophical instruction ; I merely wish to convince you that my plan is not quite so chimerical as you were at first inclined to believe."

" Upon my word," said the vicar, " you are the very counterpart of Cornelius Scriblerus ; but I must confess that your scheme is plausible, very plausible, and I shall no longer refuse to attend you in the progress of its execution.

'Cedo equidem, nec nate, tibi comes ire recuso,'*

as Virgil has it."

Mr. Seymour, however, saw very plainly that, although the vicar thus withdrew his opposition, he was nevertheless very far from embarking in the cause with enthusiasm, and that, upon the principle already discussed, he would perform his part rather as a *task* than a *pastime*. Nor was the line which Mr. Twaddleton

* " I yield, my son, and no longer refuse to become your associate." — *Æn.* ii. 704.

had quoted from the *Æneid* calculated to efface such an impression. It was true, that, like Anchises, he no longer refused to accompany him in his expedition ; but, if the comparison were to run parallel, it was evident that he would have to carry him as a dead weight on his shoulders. This difficulty, however, was speedily surmounted by an expedient, with which the reader will become acquainted by the recital of what followed.

“ I rejoice greatly,” said Mr. Seymour, “ that we have at length succeeded in enlisting you into our service : without your able assistance, I fear that my instruction would be extremely imperfect ; for you must know, my dear sir, that I am ambitious of making Tom an antiquary as well as a philosopher, and I look to you for a history of the several toys which I shall have occasion to introduce.”

This propitiatory sentence had its desired effect.

“ Most cheerfully shall I comply with your wishes,” exclaimed the delighted vicar ; “ and I can assure you, sir, that, with regard to several of the more popular toys and pastimes, there is much very curious and interesting lore.”

Mr. Seymour had, upon this occasion, succeeded in opening the heart of the vicar, just as a skilful mechanic would pick a patent lock; who, instead of forcing it by direct violence, seeks to discover the secret spring to which all its various movements are subservient.

“To-morrow, then,” cried the vicar, in a voice of great exultation, “we will commence our career, from which I anticipate the highest satisfaction and advantage; in the meantime,” continued he, “I will refresh my memory upon certain points touching the antiquities of these said pastimes, or, as we used to say at college, *get up* the subject.”

Mr. Seymour cast an intelligible glance at his wife, who was no less surprised at the sudden change in the vicar’s sentiments than she was pleased with the skill and address by which it had been accomplished.

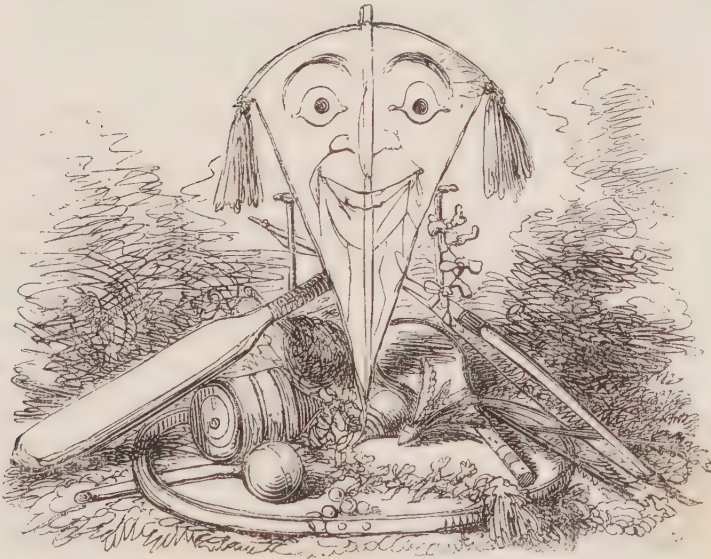
“To-morrow!” said Tom.

“To-morrow!!” echoed Fanny.

“To-morrow, and to-morrow, and to-morrow,” sighed Louisa; “why not to-day? for it is not yet one o’clock.”

“Be it so,” replied her father, “and I hope that Mr. Twaddleton will afterwards join our family circle at dinner.”

The vicar accepted the invitation, but observed that his parochial duties obliged him to absent himself for an hour, after which he faithfully promised to return. The good-humoured clergyman then shook Tom by the hand, and departed in company with Mr. Seymour, while the juvenile party were left to their amusements in the garden.





CHAP. III.

ON GRAVITATION — WEIGHT — THE VELOCITY OF FALLING BODIES. — AT WHAT ALTITUDE A BODY WOULD LOSE ITS GRAVITY. — THE TOWER OF BABEL. — THE KNOWN VELOCITY OF SOUND AFFORDS THE MEANS OF CALCULATING DISTANCES. — AN EXCURSION TO OVERTON WELL. — AN EXPERIMENT TO ASCERTAIN ITS DEPTH. — AN UNWELCOME VISITOR. — THE MYSTERIOUS SISTERHOOD. — AN INCANTATION SCENE. — A VISIT TO THE VICARAGE. — THE MAGIC GALLERY. — RETURN TO THE LODGE.

It was about two o'clock, when Mr. Twaddleton, in company with Mr. and Mrs. Seymour, joined the children on the lawn.

"Tom," said his father, "are you prepared to commence the proposed examination?"

"Quite ready, papa."

"Then you must first inform me," said Mr. Seymour, taking the ball out of Rosa's hand, "why this ball falls to the ground, as soon as I withdraw from it the support of my hand?"

"Because every *heavy* body, that is not supported, must of course fall."

"And every *light* one also, my dear; but that is no answer to my question; you merely assert the fact, without explaining the reason."

"Oh! now I understand you; it is owing to the force of gravity; the earth attracts the ball, and the consequence is, that they both come in contact; — is not that right?"

"Certainly; but if the earth attract the ball, it is equally true that the ball must attract the earth; for you have, doubtless, learnt that bodies mutually attract each other: tell me, therefore, why the earth should not rise to meet the ball."

“ Because the earth is so much larger and heavier than the ball.”

“ It is, doubtless, much larger, and since the force of attraction is in proportion to the mass, or quantity of matter, you cannot be surprised at not perceiving the earth rise to meet the ball, the attraction of the latter being so infinitely small, in comparison with that of the former, as to render its effect wholly nugatory ; but with regard to the earth being heavier than the ball, what will you say when I tell you that it has no weight at all ?”

“ No weight at all ! oh, now you are trying to puzzle me, as mamma did last evening, when she asked me if I could tell her what an Indian-man, laden with merchandize, weighs before she sets sail ; you may suppose how the question puzzled me ; and as I was proceeding to enquire the particulars which I supposed to be necessary for the solution of the problem, Louisa, who was in the secret, cried out, ‘ goose ! goose !! goose !!! does not she *weigh* anchor ?’ ”

“ *Punica fides,*” muttered Mr. Twaddleton, and casting at Mrs. Seymour a look of remon-

strance, which was well understood by the whole party, he exclaimed —

“ ‘ You palter with us in a double sense,
That keeps the word of promise to the ear,
And breaks it to our hope.’ ” *

Tom begged that his father would explain to him how it could possibly be that the earth should not possess any weight.

“ Weight, my dear boy, you will readily understand, can be nothing more than an effect arising out of the resisted attraction of a body for the earth: you have just stated, that all bodies have a tendency to fall, in consequence of the attraction of gravitation; but if they be supported, and prevented from approaching the earth, either by the hand, or any other appropriate means, their tendency will be felt, and is called *weight*.”

Tom understood this explanation, and observed, that “ since attraction was always in proportion to the quantity of matter, so, of course, a larger body must be more powerfully attracted, or be *heavier*, than a smaller one.”

“ Magnitude, or size, my dear, has nothing

* Macbeth.

whatever to do with quantity of matter: will not a small piece of lead weigh more than a large piece of sponge? In the one case, the particles of matter may be supposed to be packed in a smaller compass; in the other, there must exist a greater number of pores or interstices."

"I understand all you have said," observed Louisa, "and yet I am unable to comprehend why the earth cannot be said to have any weight."

"Cannot you discover," answered Mr. Seymour, "that, since the earth has nothing to attract it, it cannot have any attraction to resist, and, consequently, cannot be correctly said to possess weight?"

The children declared themselves satisfied with this explanation, and Mr. Seymour proceeded to put another question: "since," continued he, "you now understand the nature of that force by which bodies fall to the earth, can you tell me the degree of velocity with which they fall?"

Tom asserted, that the weight of the body, or its quantity of matter, and its distance from the surface of the earth, must, in every case,

determine that circumstance ; but Mr. Seymour excited his surprise by saying, that it would not be influenced by either of those conditions ; he informed them, for instance, that a cannon ball, and a marble, would fall through the same number of feet in a given time, and that, whether the experiment were tried from the top of a house, or from the summit of Saint Paul's, the same result would be obtained.

“ I am quite sure,” exclaimed Tom, “ that, in the *Conversations on Natural Philosophy*, it is positively stated, that *attraction is always in proportion to the quantity of matter.*”

“ Yes,” observed Louisa, “ and it is moreover asserted, that the *attraction diminishes as the distances increase.*”

Mr. Seymour said, that he perceived the error under which his children laboured, and that he would endeavour to remove it. “ You cannot, my dears,” continued he, “ divest your mind of that erroneous but natural feeling, that a body necessarily falls to the ground without the exertion of any force ; whereas the greater the quantity of matter, the greater must be the force exerted to bring it to the earth : for in-

stance, a substance which weighs a hundred pounds will thus require just ten times more force than one which only weighs ten pounds; and hence it must follow, that both will come to the ground at the same moment; for, although, in the one case, there is ten times more matter, there is, at the same time, ten times more attraction to overcome its resistance; for you have already admitted that the force of attraction is always in proportion to the quantity of matter: now let us only for an instant, for the sake merely of argument, suppose that attraction had been a force acting without any regard to quantity of matter, is it not evident that, in such a case, the body containing the largest quantity would be the slowest in falling to the earth?"

"I understand you, papa," cried Tom; "if an empty waggon travelled four miles an hour, and were afterwards so loaded as to have its weight doubled, it could only travel at the rate of two miles in the same period, provided that in both cases the horses exerted the same strength."

"Exactly," said Mr. Seymour; "and to follow up your illustration, it is only necessary

to state, that Nature, like a considerate master, always apportions the number of horses to the burthen that is to be moved, so that her loads, whatever may be their weight, always travel at the same rate ; or, to express the fact in philosophical instead of figurative language, gravitation, or the force of the earth's attraction, always increases as the quantity of matter, and, consequently, that heavy and light bodies, when dropped together from the same altitude, must come to the ground at the same instant of time."

Louisa had listened with great attention to this explanation ; and although she thoroughly understood the argument, yet it appeared to her at variance with so many facts with which she was acquainted, that she could not give implicit credence to it.

" I think, papa," said the archly smiling girl, " I could overturn this fine argument by a very simple experiment."

" Indeed ! miss Sceptic : then pray proceed ; and I think we shall find that the more strenuously you oppose it, the more powerful it will become : but let us hear your objections."

“ I shall only,” replied she, “ drop a shilling, and a piece of paper, from my bed-room window upon the lawn, and request that you will observe which of them reaches the ground first ; if I am not much mistaken, you will find that the coin will strike the earth before the paper has performed half its journey.”

Tom appeared perplexed, and cast an enquiring look at his father.

“ Come,” said Mr. Seymour, “ I will perform this experiment myself, and endeavour to satisfy the doubts of our young sceptic ; but I must first take the opportunity to observe, that I am never better pleased than when you attempt to raise difficulties in my way, and I hope you will always express them without reserve.”

“ Here, then, is a penny piece ; and here,” said Tom, “ is a piece of paper.”

“ Which,” continued Mr. Seymour, “ we will cut into a corresponding shape and size.” This having been accomplished, he held the coin in one hand, and the paper disc in the other, and dropped them at the same instant.

“ There ! there !” cried Louisa, with an air of triumph ; the “ coin reached the ground long before the paper.”

“ I allow,” said Mr. Seymour, “ that there was a distinct interval in favour of the penny piece ;” and he proceeded to explain the cause of it. He stated, that the result was not contrary to the law of gravitation, since it arose from the interference of a foreign body, the air, to the resistance of which it was to be attributed ; and he desired them to consider the particles of a falling body as being under the influence of two opposing forces, — gravity, and the air’s resistance. Louisa argued, that the air could only act on the surface of a body, and as this was equal in both cases (the size of the paper being exactly the same as that of the penny piece), she could not see why the resistance of the air should not also be equal in both cases.

“ I admit,” said Mr. Seymour, “ that the air can only act upon the surface of a falling body, and this is the very reason of the paper meeting with more resistance than the coin ; for the latter, from its greater density, must contain a great many more particles than the paper, and upon which the air cannot possibly exert any action ; whereas almost every particle of the paper may be said to be exposed to its resistance, the fall

of the latter must therefore be more retarded than that of the former body."

At this explanation Louisa's doubts began to clear off, and they were ultimately dispelled on Mr. Seymour performing a modification of the above experiment in the following manner. He placed the disc of paper in close contact with the upper part of the coin, and, in this position, dropped them from his hand. They both reached the ground at the same instant.

"Are you now satisfied, my dear Louisa?" asked her father: "you perceive that, by placing the paper in contact with the coin, I screened it from the action of the air, and the result is surely conclusive."

"Many thanks to you, dear papa; I am perfectly satisfied, and shall feel less confident for the future." Tom was delighted; for, as he said, he could now understand why John's paper *parachute* descended so deliberately to the ground; he could also explain why feathers, and other light bodies, floated in the air. "Well then," said Mr. Seymour, "having settled this knotty point, let us proceed to the other question, *viz.* 'that a body will fall with the same velocity, during a given number of feet, from the ball of

St. Paul's as from the top of a house.' You maintain, I believe, that, since the attraction of the earth for every body diminishes as its distance from it increases, a substance at a great height ought to fall slower than one which is dropped from a less altitude."

Neither Tom nor Louisa could think otherwise. Mr. Seymour told them that, *in theory*, they were perfectly correct, but that, since attraction acted from the centre, and not from the surface of the earth, the difference of its force could not be discovered at the small elevations to which they could have access; "for what," said he, "can a few hundred feet be in comparison with four thousand miles, which is the distance from the centre to the surface of our globe? — You must therefore perceive that, in all ordinary calculations respecting the velocity of falling bodies, we may safely exclude such a consideration."

"But suppose," said Tom, "it were possible to make the experiment a thousand miles above the earth, would not the diminished effect of gravity be discovered in that case?"

"Undoubtedly," replied his father; "indeed, it would be sensible at a much less distance: for

instance, if a lump of lead, weighing a thousand pounds, were carried up only four miles, it would be found to have lost two pounds of its weight." (2)

"This discussion," observed Mr. Twaddleton, "reminds me of a problem that was once proposed at Cambridge, to find the elevation to which the Tower of Babel could have been raised, before the stones would have entirely lost their gravity."

"Its solution," said Mr. Seymour, "would require a consideration which Tom could not possibly understand at present, viz. the influence of the *centrifugal force*."

"I am fully aware of it," replied the vicar, "and in order to appreciate that influence, it would, of course, be necessary to take into account the latitude of the place; but, if my memory serves me, I think that, under the latitude of 30° , which I believe is nearly that of the plains of Mesopotamia, the height would be somewhere about twenty-four thousand miles."

Mr. Seymour now desired Tom to inform him, since all bodies fall with the *same* velocity, what that velocity might be.

"Sixteen feet in a second, papa; — I have just remembered that I had a dispute with a

schoolfellow upon that subject, and in which, thanks to Mrs. Marcet, I came off victorious, and won twelve marbles."

"Then let me tell you, my fine fellow, that unless your answer exclusively related to the *first* second of time, you did not win the marbles fairly; for, since the force of gravity is continually acting, so is the velocity of a falling body continually increasing, or it has what is termed an '*accelerating velocity*;' it has accordingly been ascertained by accurate experiments, that a body descending from a considerable height falls sixteen feet, as you say, in the *first* second of time; but *three times sixteen* in the next; *five times sixteen* in the third; and *seven times sixteen* in the fourth; and so on, continually increasing according to the odd numbers 1, 3, 5, 7, 9, 11, &c., so that you perceive," continued Mr. Seymour, "by observing the number of seconds which a stone requires to descend from any height, we can discover the altitude, or depth, of the place in question."

Louisa and Fanny, who had been attentively listening to their father's explanation, interchanged a smile of satisfaction, and, pulling Tom towards them, whispered something which was inaudible to the rest of the party.

“Come, now,” exclaimed Mr. Seymour, “I perceive by your looks that you have something to ask of me: is Louisa sceptical again?”

“Oh dear no,” replied Tom; “Louisa merely observed, that we might thus be enabled to find out the depth of the village well, about which we have all been very curious; for the gardener has told us that it is the deepest in the kingdom, and was dug more than a hundred years ago.”

Mr. Seymour did not believe that it was the deepest in the kingdom, although he believed that its depth was considerable; and he said that, if Mr. Twaddleton had no objection, they should walk to it, and make the proposed experiment.

“Objection! my dear Mr. Seymour, when do I ever object to afford pleasure to my little play-mates, provided its indulgence be harmless? Let us proceed at once, and on our return I hope you will favour me with a visit at the vicarage; I have some antiquities which I am anxious to exhibit to yourself and Mrs. Seymour.” Tom and Rosa each took the vicar’s hand, and Mr. and Mrs. Seymour followed with Louisa and Fanny. The village well was about half a mile distant; the road to it led through a delightful shady lane, at the top of

which stood the vicarage-house. Mr. and Mrs. Seymour and her daughters had lingered in their way to collect botanical specimens, and when they had come up to Tom and the vicar, they found them seated on the trunk of a newly-felled oak, in deep discourse.

“What interests you, Tom?” said Mr. Seymour, who perceived, by the enquiring and animated countenance of the boy, that his attention had been excited by some occurrence.

“I have been watching the woodman,” said Tom, “and have been astonished to observe that the sound of his hatchet was not heard until some time after he had given the stroke.”

“And has not Mr. Twaddleton explained to you the reason of it?” asked Mr. Seymour.

“He has,” replied Tom, “and he tells me that it is owing to sound travelling so much slower than light.”

“You are quite right, and as we are upon an expedition for the purpose of measuring depths, it may not be amiss to inform you, that this fact furnishes another method of calculating distances.”

The party seated themselves upon the oak, and Mr. Seymour proceeded: “The stroke of

the axe is seen at the moment the woodman makes it, on account of the immense velocity with which light travels; but the noise of the blow will not reach the ear until some time has elapsed, the period varying, of course, in proportion to the distance, because sound moves only at the rate of 1142 feet in a second, or about 13 miles in a minute; so that you perceive, by observing the interval between the fall of the hatchet and the sound produced by it, we can ascertain the distance of the object."

Mr. Seymour fixed his eye attentively on the woodman, and, after a short pause, declared that he was about a quarter of a mile distant.

"Why, how could you discover that?" cried Louisa; "you had not any watch in your hand."

"But," said Mr. Seymour, "you might have perceived that I placed my finger on my wrist, and as my pulse beat about 75 strokes in a minute, I was able to form a tolerable estimate of the interval, although I confess that it is a very rough experiment, but sufficiently accurate for the purpose of illustration. In the same manner we can readily ascertain the distance of a thundercloud, or that of a vessel at sea firing

a cannon. If we do not hear the thunder till half a minute after we see the lightning, we are to conclude the cloud to be at the distance of six miles and a half;—but let us proceed to the well.”

After a walk of a few minutes, the party reached the place of destination. On their arrival, Mr. Seymour enquired who would count the time.

“Be that my office,” said Mr. Twaddleton, as he extracted a large silver time-piece from the dark abyss of his watch-pocket; “and let Tom,” continued he, “find a pebble.”

“Here is one,” cried Louisa.

“Very well: now, then,” asked Mr. Seymour, “how will you proceed?”

“I shall drop the stone,” replied Tom, “into the well, and observe how many seconds it will be before it touches the water, and I shall then set down the number of feet it will fall in each second, and add up the numbers.”

“That,” said Mr. Seymour, “would certainly accomplish your object; but I can give you a neater, as well as a shorter rule for performing the sum: you shall, however, first work

it in your own way; — but you have not yet informed me how you propose to ascertain the moment at which the stone reaches the water.”

“ By the sound, to be sure, papa; and you will find that a very loud one will be produced.”

“ If the depth of the well be considerable, such an expedient will not answer the purpose, since, in that case, there must necessarily be a perceptible interval between the fall of the stone and the sound produced by it, which, unless taken into account, (3) will vitiate the result.”

Tom observed that he had not contemplated that difficulty, and was unable to propose any remedy for it. His father told him, that he must look at the surface of the water, and mark the moment it was disturbed by the contact of the stone.

“ Now, Mr. Twaddleton,” exclaimed Mr. Seymour, “ are you ready to count the seconds?”

“ Quite ready.”

“ Then drop the stone.”

“ One, — two, — three, — four —

“ There,” said Tom, “ it touched the water.”

“ And there, there,” cried several voices, “ what a prodigious noise it occasioned !”

“*Facilis descensus Averni*,” exclaimed the vicar ; “the stone descended in four seconds.”

“Now, my boy, make your calculation.”

Mr. Seymour furnished pencil and paper, and Tom proceeded ; — “*Sixteen* feet for the first second, — I put that down.” —

“Well,” said his father,” and *three* times *sixteen* for the second ?”

“*Forty-eight*,” cried Tom. —

“Put it down.”

“*Five times sixteen*, for the third ?”

“*Eighty*.” —

“Down with it.”

“And *seven times sixteen*, for the fourth ?”

“*One hundred and twelve*.”

“Now, cast up these numbers,” said Mr. Seymour.”

“*Two hundred and fifty-six feet*,” cried Tom, “is the depth of the well.”

A shout of delight, from the whole juvenile party, announced the satisfaction which they felt at the success of their first experiment in NATURAL PHILOSOPHY.

Louisa observed, that she could not distinguish any interval between the actual contact

of the stone with the water and the sound which it produced.

“ At so small a distance as two hundred and fifty-six feet,” said her father, “ the interval could not have exceeded in duration the fourth part of a second, and was, consequently, imperceptible : we might therefore, in the present instance, have accepted the sound as a signal of the stone’s arrival at the water, without prejudice to the result of the experiment.”

Mr. Seymour told his son, that the method which he had pursued was unobjectionable when the experiment did not extend beyond a few seconds ; but that, if a case occurred in which a greater space of time were consumed, he would find his plan tedious : “ now,” continued he, “ I will give you a general rule that will enable you to obtain the answer in a shorter time without the details of addition. ‘ *The spaces described by a falling body increase as the squares of the times increase.*’ I conclude that you already know that the *square* of a number is the sum obtained by multiplying the number into itself.”

“ Certainly,” answered Tom ; “ the square of 4 is 16 ; that of 3, 9, and so on.”

“ This, then, being the case, you have only to square the number of seconds, and then multiply that product by 16, being the space described by the falling body in the first second, and you will have the required answer: apply this rule to the present case; the stone fell to the bottom in four seconds; square this number, $4 \times 4 = 16$; multiply this by 16, and we obtain 256.”

“ That,” said Tom, “ is certainly much more simple than my method.”

“ And it has the advantage,” continued Mr. Seymour, “ of being more portable for the memory.”

Louisa was desirous of repeating the experiment, but her wishes were suddenly frustrated by the unwelcome appearance of Miss Kitty Ryland. This worthy lady, as she sat at the bow-window of her little parlour, had caught a glimpse of the party as they were proceeding through Forest-lane, and, being very inquisitive as to the object of their excursion, had hastily put on her silk bonnet, with a determination to watch their movements. She had, accordingly, witnessed the whole of the proceedings at the well, having taken especial care to conceal her person behind the trunk of an old oak, at some

little distance ; and our readers will readily suppose that the operation she had witnessed was rather calculated to increase than appease the cravings of her inordinate curiosity.

“ So, Mr. Twaddleton,” she exclaimed, as she emerged liked a Hamadryad from her sylvan retreat, “ I perceive that you have been teaching these young persons how to tell their fortunes ; methinks, it would have been more consistent with your sacred office to have ridiculed the superstitions which attach to Overton Well, than to have encouraged a belief in its powers by bringing the inmates of the Lodge to sanction it.”

“ What can Miss Ryland mean ?” asked Louisa, in a half whisper to her mamma.

“ My dear,” replied Mrs. Seymour, “ there is a foolish superstition attached to this, and I believe to many other wells in the neighbourhood of remote villages, that by dropping pebbles into it, and observing whether they produce a loud, or only a slight sound, and noticing the number of times they rebound from the sides before they reach the bottom, and other absurd distinctions, a person can predict whether good or evil awaits them.” (4)

“And can this be seriously believed,” exclaimed Louisa, “by any of the villagers?”

“By no one, I fancy,” answered her mother, “more implicitly than by Miss Kitty herself. I have repeatedly seen her in the act of dropping pebbles into the well; and it is so well known to all the villagers, that if she looks more than usually dismal at church, the girls are sure to say, “Poor Miss Kitty has received some bad news from the well this morning.”

Mr. Seymour assured the worthy lady that she was quite mistaken in ascribing a superstitious motive to their occupation: “*we*,” said he, and he pronounced that monosyllable with studied emphasis, “are no believers in witchcraft: the fact is, that our kind and worthy friend the vicar has been superintending an experiment which I was desirous of performing for the instruction of my children.”

“Umph!” cried Miss Kitty, — “an experiment!—the vicar superintend an experiment!—but I beg,” continued she of vinegar aspect, “that you will not consider me in any way interested in the affair; our meeting was purely accidental, and had I been in the least aware of your engagement in this spot, believe me, I

should carefully have avoided the intrusion." — So saying, she curtsied to the ladies, and having bestowed a heartless smile upon Mr. Seymour, and a malicious glance upon the vicar, she bounced forward, like a cork out of a soda water bottle, inwardly vowing that she would get to the bottom of the mystery with as little delay as the pebble fell to the bottom of the well.

"Did you observe," said the vicar, "the fiery glance of the dragon's eye? '*Oculis micat acribus ignis*,' as Virgil has it."

"When the female tongue is silenced," replied Mrs. Seymour, "the eye is the only thoroughfare left for our rage; and if the demon cannot find an exit through the usual portal, it is better that it should escape through the window."

"True," said her husband; "but the breast of Miss Kitty is the residence of several demons, most of whom are as handmaids to that restless spirit, curiosity: if that could once be lulled into repose, malignity and her train would expire from want of occupation."

"Remember that," said Mrs. Seymour to her daughters: "I agree with your papa in regarding

restless curiosity as the bane of the female character. Miss Marjory Noodleton and Miss Phillis Tapps are certainly as inquisitive as Miss Ryland or Miss Puttle, but they are by no means so malicious," added Mrs. Seymour.

"There is not a shade of difference," cried Mr. Seymour, "in any member of the coterie; they are all equally active, though differently engaged in the manufacture of their poisoned arrows: the one furnishes the raw material, the second forges it into form, the third sharpens and arms its point, and the fourth supplies it with wings."

"It is certainly extraordinary," said Mrs. Seymour, "with what ingenuity and address they collect, and then distort, every incident in a family."

Louisa enquired by what means they were enabled to obtain all their information.

"My love," replied her father, "you have just heard of the superstition which attaches to Overton well: I will now relate a history no less wonderful, but far more true. — Miss Kitty Ryland belongs to a sisterhood, who, by the aid of certain spells, are enabled to discover the

secret history of every person who ventures to approach their mystic circle ; nay, they even assume to themselves the power of prophecy, and that of casting the destinies of their acquaintances.”

“ What can you mean ?” exclaimed Louisa.

“ Hear my story : — you must know, then, that they periodically assemble at each other’s houses, for the performance of their gloomy rites.” —

“ At twelve o’clock at night, I dare say,” said Louisa.

“ No, my love, never later than five o’clock in the afternoon ; when, having arranged themselves in a circle, a damsel, dressed in her best apparel for the occasion, enters with the sacred vessels, and arranges them in great order on a tripod, or altar, previously placed for their reception. — The ceremony now commences : the mistress of the house, in which they may happen to assemble, performs the duties of officiating priestess, and having placed before her the caldron in which the mystic ingredients are to be prepared, she proceeds to collect from a cabinet of silver, or ebony, a number of leaves gathered in the remotest corner of the globe ; but these,

unlike those of the Cumæan Sibyl, which, as Mr. Twaddleton will inform you, served to interpret the decrees of the Priestess of Apollo, are designed to exhilarate and inspire the prophetesses of Overton; and, instead of becoming the sport of Æolus, are consigned to the nymph of the well, whom Vulcan has previously warmed by his addresses, and prepared for the requisite duties. The incantation having been thus far accomplished, the inspiring liquor is transfused into subordinate vessels.”—

“And what can they do with it?” said Louisa, whose attention had been painfully riveted to the subject.

“You shall hear; — it is first impregnated with the type of hypocrisy, and then consigned to a cavern.”—

“To the *wolf’s glen*, I suppose,” exclaimed Louisa, who had been just reading the romance of *Der Freischütz*.

“You are right, my dear; that is its appropriate name.”

“But who carries it thither?” enquired Louisa.

“Two twin sprites,” said Mr. Seymour, “who are the emblems of avarice; shriveled in aspect,

and meagre in form, ever active and vigilant in seizing the property of others, but never known to relax their hungry grasp, though famine should solicit their mercy."

"Horrible!" cried Fanny.

"Pray proceed, papa," said Louisa.

"The female minister, whom I have before mentioned, now advances with solemn step, and presents to each of the demons a scroll, previously prepared for the occasion by a peculiar species of varnish, and which, from the extreme caution displayed in its application, may be supposed to be rare and costly; these scrolls are eagerly carried off by the aforesaid sprites, in order that they may be deposited in the cavern above described; but they rarely reach their destination in safety, being generally torn in pieces by aged skeletons which stray about the entrance of the den. The sprites, in compliance with prescriptive usage, appear in ancient robes of white leather; but, on preparing to carry their offerings to the cavern, they usually divest themselves of these shackles of vanity, throw down the gauntlet, like true knight errants, and proceed to the discharge of their duties in a primeval state of nudity! The influence of these

mysterious rites is first manifested in the countenances of the sisterhood ; their features gradually become distorted by a malignant smile, and, after a short interval, the name, or frequently only some circumstance connected with the history of the victim, is pronounced in a whispering mutter from the cavern ; the eyes of the presiding priestess now flash fire, — the blood forsakes her cheeks, — and a torrent of invective bursts from her quivering lips : like the Pythian priestess, she raves and utters sentences so dark in their meaning, that those alone initiated in the mystery can scan their ominous import.”

“ Wonderful !” said Louisa.

“ Most mysterious !” cried Fanny.

“ Unintelligible !” exclaimed Tom, as he rose from the bank, upon which he had been reclining.

“ Most excellent !” said Mr. Twaddleton, who had very soon discovered the meaning of the speaker.

“ Uncharitable,” observed Mrs. Seymour ; “ if all our errors were thus magnified by the magic mirror of allegory, which of us would appear spotless ?”

“ I confess,” said Louisa, “ that *to me* all

this is a perfect mystery: if Mr. Twaddleton understands it, and I conclude from his arch smile that he is in the secret, I wish he would be so obliging as to enlighten us."

"My dear," exclaimed her mother, "you are really unusually dull this morning; — your papa has been merely describing what the maiden ladies of Overton call a *sociable cup of tea*." —

"And which," added Mr. Seymour, "they convert into a vehicle for the most abominable scandal; — you surely now comprehend it, Louisa? — 'The sacred vessels' are no other than the tea things; — 'the tripod,' the mahogany table; — 'the mystic caldron,' the teapot; — 'the damsel of neat attire,' a maid servant of six pounds per annum; — 'the leaves gathered in the remotest corner of the globe,' six shilling Bohea; — 'the nymph of the well favoured by Vulcan,' boiling water; — 'the wolf's glen,' the hungry jaws of Miss Kitty and her cronies; — 'the twin sprites,' her shriveled hands; — 'the ancient robes of white leather,' kid gloves, over which Time has cast its dingy shadows; — 'the scrolls,' slices of bread; — 'the precious varnish,' salted butter; —

‘ the aged skeletons,’ the frail remnants of a once respectable row of ivories.”

“ Excellent, most excellent ! but you have not yet told us what is meant by the extract of hypocrisy.”

“ Be that pleasure,” exclaimed Mr. Twaddleton, “ reserved for me ; — it is sugar, child, sugar ; — the sweat from the Negro’s brow ; the accursed fruit of slavery and oppression : is it not as *white* as driven snow ? and yet its source is as *black* as Styx : — is it not *sweet* ? and yet wrung from the *bitterest* dregs of misery and despair. — Who then, I will ask, can say that it is not the emblem and type of hypocrisy ? ”

The worthy vicar pronounced these words with such energy as to astonish the listening group, who, with the exception of Mr. Seymour, were not aware that he had published a sermon against the slave-trade, from which Mr. Seymour had borrowed the idea respecting sugar. This circumstance will account for the readiness with which the vicar had discovered Mr. Seymour’s allegory.

Mrs. Seymour now proposed the party’s return to the Lodge ; but Mr. Twaddleton expressed a hope that they would first favour him

with a visit at the vicarage; to which proposition they readily assented.

His antiquated residence, mantled in ivy, and shaded by cypress, stood on the confines of the church-yard, from which his grounds were merely separated by a dwarf hedge of sweet-briar and roses; so that the vicar might be said to reside amidst the graves of his departed parishioners, and the turf-clad heap evinced the influence of his fostering care by a grateful return of primroses and violets.

Around the house the reverend antiquary had arranged several precious relics, which were too cumbrous for admission within its walls; amongst these was an ancient cross, raised upon a platform on three steps, which from the worn appearance of the stones had evidently been impressed with the foot of many a wandering pilgrim. These mouldering monuments of ancient days cast a shade of solemnity around the dwelling, and announced its inmate as a person of no ordinary stamp.

Annette, the vicar's trusty servant, had watched the approach of the squire and his family, and, anticipating the honour of a passing visit, was busily engaged in removing the

chequed covers from the cumbrous oaken chairs, when the party entered the study. Lucky was it for the vicar's repose, that the notice had been so short, or the tidy housewife would, without doubt, have scoured some of the antique ornaments, and destroyed a crop of sacred verdure, which ages could not have replenished. As matters stood, nothing was left for poor Annette, but to defend her character at the expence of her master, who she declared treated her as he would an old witch, whenever she appeared with a *broom*.

"Why, papa," exclaimed Tom, as he cast his eyes around the study, "all these curiosities have been put up since I went to school."

"The boy is right," said the vicar; "I have only just completed their arrangment, and I believe," continued he, addressing himself to Mr. Seymour, "that there are several rich morsels of antiquity which you have not yet seen."

"Pray," cried Mr. Seymour, "allow me to enquire whether there is not some curious tradition connected with that rusty sword which hangs in such grim repose over your mantelpiece? If my memory serves me, I think you

told me it was the identical weapon with which Balaam killed his ass ?”

“ With which Balaam killed his ass !!” exclaimed the horrified vicar ; “ let me tell you, sir, that Balaam *never did* kill his ass ; although I confess that he *wished* for a sword for that purpose ; since he exclaimed, in a moment of wrath, ‘ *I would there were a sword in my hand, for now would I kill thee.*’ ” *

“ I stand corrected,” said Mr. Seymour : “ that sword then is, doubtless, the one for which he so anxiously *wished*.”

“ You are really incorrigible,” cried Mr. Twaddleton ; “ but I must beg that, for the present at least, you will repress your rallery ; for I now propose to introduce my young friends to the wonders of my magic gallery ; wherein they may converse with the spirits of departed emperors, heroes, patriots, sages, and beauties ; — contemplate, at their leisure, the countenances of the Alexanders, Cæsars, Pompeys, and Trajans ; — behold a legion of allegorical and airy beings, who have here, for the first time, assumed appropriate and substantial forms ; — examine the models

* Numbers, xxii, 29.

of ancient temples and triumphal arches, which, although coeval with the edifices they represent, are as perfect as at the first moment of their construction, while the originals have long since crumbled into dust. They shall also see volumes of history, condensed into a space of a few inches, and read the substance of a hundred pages at a single glance."

"How extraordinary!" said Tom: "why we never read any thing more wonderful in our Fairy Tales."

"And what renders it more wonderful," replied the vicar, "is its being all true."

So saying, the antiquary took a key of pigmy dimensions from the pocket of his waistcoat, and proceeded to a cumbrous ebony cabinet which stood in a deep recess, and displayed an antique structure, and curiously carved allegorical devices, in strict unison with that air of mystery with which the vicar had thought proper to invest its contents. It was supported by gigantic eagles' claws; its key-hole was surrounded by hissing snakes; while the head of Cerberus, which constituted the handle, appeared as if placed to guard the entrance. The

children were upon the tiptoe of expectation and impatience — the lock yielded, and the doors flew open. Disappointment and chagrin were visibly depicted on the countenances of the brother and sisters.

“ And so,” exclaimed Tom, “ this fine magic gallery turns out to be nothing more than a box full of rusty halfpence !”

“ I am sure,” said Louisa, “ it was quite unnecessary to have engaged Cerberus as a sentinel over such rubbish.”

“ Hush !” cried the vicar ; “ you talk like one not initiated in the mysteries of enchantment : have you not read, that under its spells the meanest objects have assumed forms of splendor and magnificence ? In like manner, then, may treasures of the greatest value appear to ordinary eyes as mean and worthless.

“ This cabinet,” continued Mr. Twaddleton, “ is under the influence of a potent magician : by the touch of her wand, it would become irradiated as with celestial light, and these rusty coins would be transformed into all those various objects of interest and delight which I had promised to show you.”

Tom and Louisa looked at the coins, then at the vicar, and afterwards at Mr. Seymour, to whom they cast an enquiring glance.

“Then pray,” exclaimed Tom, “wave this mighty wand of your enchantress, and fulfil your promise.”

“The enchantress,” replied the vicar, “is not disposed to grant her favours to those by whom she has not been propitiated.”

“And what ceremony does she exact?” enquired Louisa.

“The perusal of sundry mystic volumes; and the consumption of a midnight lamp at her altar,” replied the vicar.

“Do you not comprehend the allegory?” said Mr. Seymour: “you are really, Louisa, as dull as you were at the well, when I described the tea-party of Miss Ryland. The enchanted gallery is no other than a collection of antique medals;—the potent enchantress, ERUDITION, or that classical learning, without which they appear of less value than so many rusty halfpence.”

“You are right,” cried Mr. Twaddleton: “the poetical import of a device can be alone

felt and appreciated by those who are acquainted with the classical subjects to which it alludes ; for, as Addison forcibly observes, there is often as much thought on the reverse of a medal as in a canto of Spenser ; besides, how frequently do you meet with hints and suggestions in an ancient poet, that give a complete illustration to the actions, ornaments, and antiquities which are found on coins ! — In short, the person who examines a collection of medals, without a competent knowledge of the classics, is like him who would explore a subterranean cavern without the aid of a torch.”

“ I have already learnt one fact,” said Louisa, “ with which I was certainly wholly unacquainted ; that the ancients possessed such a much greater variety of different kinds of money than modern nations.” (5)

“ Of that, my dear,” replied the vicar, “ there is some doubt ; — the learned are divided upon that question : some authors maintain that every medal, and even medallion, had its fixed and regular price in payments ; while others, on the contrary, assert that we are not in the possession of any real money of the ancients, and

that the medals never had any currency as coins. The truth probably is between these two extremes."

"If these medals were not used as money," observed Louisa, "for what purposes could they have been coined?"

"To perpetuate the memory of great actions; and, faithful to its charge of fame, the medal has transmitted events, the history of which must, otherwise, have long since perished. Nay, more," exclaimed the vicar, his voice rising as he became warmed by his subject, "the lamp of history has been often extinguished, and the medalist has collected sparks from the ashes of antiquity which have rekindled its flame. You perceive, therefore," continued the reverend antiquary, "that such collections are of the highest importance, and if your papa will allow you to pass a morning in their examination, I shall easily bring you to admit, that I have not exaggerated the wonders of my magic gallery. I will convince you, that it contains a series of original miniature portraits of the greatest heroes of antiquity; a compendious chart of history, chronology, and heathen mythology; a system of classic architecture; and an ac-

curate commentary upon the more celebrated poems of Greece and Rome. Ay — and I will show you a faithful resemblance of the very ship that carried Æneas to Italy, and of the lofty poop, from which the luckless Palinurus fell into the ocean.”

Mr. Twaddleton then informed his party, that medals were divided into those of ancient and modern date, but that his collection only embraced the former. He said that the cabinet they were then inspecting contained those of the *higher* antiquity, or such as were struck before the end of the third century: and that in the other, were arranged medals of the *lower* antiquity, having been struck between the third and ninth centuries. He then favoured Mr. and Mrs. Seymour with a sight of some of those rarer medals, which he considered as constituting the gems of his collection.

“ You do not mean to say,” exclaimed Tom, as he seized a small coin, “ that this little *brass* piece is of more value than the large coin of gold that lies next to it?”

“ Mercy upon us !” cried the vicar, in a tone of agony, “ how the boy handles it ! — restore it to its place — gently — gently — that ‘ little

brass piece' as you call it, although it might not have been worth a penny fifteen hundred years ago, is now valued at more than a hundred guineas."

"There is, certainly," said Mr. Seymour, "something very inexplicable in the tastes and feelings of you patrons of antiquity; nor is there any thing with which I can compare you, except, perhaps, with those Dilettanti sons of the bottle, who regard, as so much poison, the generous and full-bodied wines of Oporto, while you extol, even to the seventh heaven, the juice that has fretted itself into insipidity, if not into sourness."

"The antiquary," observed the vicar, "does not regard a cabinet of medals as a treasure of money, but of knowledge; nor does he fancy any charms in gold, but in the figures that adorn it; it is not the metal, but the erudition, that stamps it with value."

The party, soon after this discussion, quitted the vicarage, and returned to the lodge, where, after the usual ceremonies at the toilet, they sat down to dinner; in the enjoyment of which we will now leave them, and put an end to the present chapter.

CHAP. IV.

MOTION — ABSOLUTE AND RELATIVE. — UNIFORM, ACCELERATED, AND RETARDED VELOCITY. — THE TIMES OF ASCENT AND DESCENT ARE EQUAL. — VIS INERTIÆ. — ACTION AND RE-ACTION ARE EQUAL AND IN OPPOSITE DIRECTIONS. — MOMENTUM DEFINED AND EXPLAINED. — THE THREE GREAT LAWS OF MOTION.

“THE table-cloth is removed,” cried Tom, as he cast a sly glance through the open window of the dining-room.

“It is, my boy,” replied Mr. Twaddleton; “*Diffugere nives**, as the poet has it.”

“*Et redeunt jam gramina campis*†,” added Mr. Seymour, as he pointed to the green cloth with which the table was covered. “Come, vicar, let us join the children.”

Mr. Twaddleton, accompanied by Mr. and Mrs. Seymour, and Louisa, rose from the table, and proceeded to the lawn.

* “The *snows* have disappeared.”

† “And the surface is again enlivened by a *green* mantle.”

“ The gravitation of Tom’s ball,” said Mr. Seymour, “ furnished an ample subject for our morning’s diversion, let us try whether its other motions will not suggest further objects of enquiry.”

“ I well remember,” observed Louisa, “ that Mrs. Marcet extols that apple, the fall of which attracted the notice of Sir Isaac Newton, above all the apples that have ever been sung by the poets : and she declares, that the apple presented to Venus by Paris ; the golden apples by which Atalanta won the race ; nay, even the apple which William Tell shot from the head of his own son, cannot be brought into comparison with it.”

“ Well said ! Mrs. Marcet,” exclaimed Mr. Seymour ; “ upon my word, had the mother of mankind used but half such eloquence in praise of an apple, we cannot wonder at its influence on Adam.”

“ What honours, then,” continued Louisa, “ shall we decree to Tom’s ball, if it instructs us in the first principles of philosophy ?”

“ It shall be duly honoured,” replied Mr. Seymour. “ We will decree it a prominent station amidst the precious archives of the vicar ; the

relics of war shall recede, and afford a space for an emblem of science,—but we are trifling:” and so saying, he took the ball from Tom’s hand, and rolling it along the ground, exclaimed, “There it goes, performing, as you may perceive, two different kinds of motion at the same time; it turns round, or revolves on its *axis*; and goes straight forward, or to speak more philosophically, performs a *rectilinear* motion.”

Tom said that he did not exactly comprehend what was meant by the *axis*. His father, therefore, informed him that the axis of a revolving body was an imaginary line, which was itself at rest, but about which all its other parts turned, or rotated: “but,” continued he, “can you tell me whether you understand what is meant by the word *motion*?”

“If he can,” exclaimed the vicar, “he is a cleverer fellow than the wisest philosopher of antiquity, who, upon being asked the very same question, is said to have walked across the room, and to have replied, ‘You see it, but what it is I cannot tell you.’”

“Your ancient acquaintances,” observed Mr. Seymour, “entertained some very strange notions touching this said subject of motion. If I remember right, Diodorus denied its very exist-

ence; but, we are told that he did not himself remain *unmoved*, when he dislocated his shoulder, and the surgeon kept him in torture while he endeavoured to convince him, by his own mode of reasoning, that the bone could not have moved out of its place: we have, however, at present, nothing to do with the ancients; the philosophers of our own times agree in defining motion to be ‘*the act of a body changing its situation with regard to any other*,’ and you will therefore readily perceive, that this may actually happen to a body while it remains absolutely at rest.”

“Well, that surpasses all the paradoxes I ever heard,” cried Tom; “a body then may be in motion, while it is at rest.”

“Certainly,” replied Mr. Seymour; “it may be *relatively* in motion, while it is *absolutely* at rest.”

“How can a body change its place,” said Louisa, “except by moving?”

“Very readily,” answered her father; “it may have its relative situation changed with respect to surrounding objects; there is your ball, and here is a stone, has not each of them a particular situation with respect to the other;

and by moving one, do I not change the *relative* situation of both?"

"I perceive your meaning," said Tom.

"To prevent confusion, therefore, in our ideas, it became necessary to distinguish these two kinds of motion from each other by appropriate terms; and, accordingly, where there has been an actual change of place, in the common acceptation of the term, the motion which produced it is termed ABSOLUTE motion; whereas, on the contrary, when the situation has been only relatively changed, by an alteration in the position of surrounding bodies, the motion is said to be RELATIVE."

"Surely, papa," said Louisa, "no person can ever mistake *relative* for *absolute* motion; whence then is the necessity of such frivolous distinctions? When a body really moves, we can observe it in the act of changing its place, and no difficulty can arise about the matter."

"Nothing, my dear, is more fallacious than our vision; the earth appears motionless, and the sun and stars *seem* as if they revolved round it; but it is scarcely necessary for me to inform you that our globe is constantly moving with considerable velocity, while the sun remains at

rest. — Mr. Sadler, the famous aëronaut," continued Mr. Seymour, "informed me, that he was never sensible of the motion of the balloon in any of his excursions, but that, as he ascended into the air, the earth always appeared as if sinking beneath him."

Mr. Twaddleton here observed, that he had heard a very curious anecdote, when he was last in London, which fully confirmed the truth of Mr. Sadler's statement. "An aëronaut," said he, "whose name I cannot at this moment recollect, had recently published a map of his voyage, and, instead of proceeding in any one line of direction, his track absolutely appeared in the form of circles, connected with each other like the links of a chain: this occasioned considerable astonishment, and, of course, some speculation, until it was at length discovered, that his apparent journey was to be attributed to the rotatory motion of the balloon, which the voyager, not feeling, had never suspected."

"And what," asked Tom, "could have been the reason of his not having felt the motion?"

His father explained to him, that we are only conscious of being in motion when the

conveyance, in which we are placed, suffers some impediment in its progress. "If," said he, "you were to close your eyes, when sailing on calm water, with a steady breeze, you would not perceive that you were moving: for you could not *feel* the motion, and you could only *see* it, by observing the change of place in the different objects on the shore; and then it would be almost impossible, without the aid of reason and experience, to believe that the shore itself was not in motion, and that you were at rest."

Mrs. Seymour here repeated the following passage from that interesting novel *Anastasius*, which she observed was beautifully descriptive of the illusive appearance to which their papa had just referred: —

"The gradually increasing breeze carried us rapidly out of the Straits of Chio. The different objects on the shore, — mountains, — valleys, — villages, — and steeples, — seemed in swift succession first advancing to meet us, then halting an instant alongside our vessel, as if to greet us on our passage, and, lastly, again gliding off with equal speed; till, launched into the open main, we saw the whole line of coast gradually dissolve in distant darkness."

“That is indeed a beautiful and very apposite illustration,” said Mr. Seymour; “and I think Louisa will now admit, that it is not quite so easy, as she at first imagined, to distinguish between *Absolute* and *Relative* motion.”

As the children now understood what was meant by the term *Motion*, their father asked them whether they could tell him what produced it.

“I can make a body move by various means,” answered Tom.

“But they may all be reduced to one,” said Mr. Seymour; “viz., some exertion which is called *Force*; thus the *force* of my hand put your ball in motion; while gravitation was the *force* which made it fall to the earth; and I must, moreover, inform you, that a body always moves in the direction of the force which impels it, and with a velocity, or rate of motion, which is proportional to its degree, or strength; and, were there no other forces in action but that which originally produced the motion, the body would proceed onwards in a right line, and with a *uniform* velocity, for ever.”

“For ever!” exclaimed Louisa.

“Ay, my dear, *for ever*; but we will discuss that question presently; you must first tell me

whether you understand what is meant by *uniform* velocity."

"I suppose that *uniform* velocity is that which is regular, and of an equal rate throughout."

"Philosophers," replied her father, "call the motion of a body *uniform*, when it passes over equal spaces in equal times. — Now, Tom, it is your turn to answer a question. Can you describe the meaning of the terms *Accelerated* and *Retarded* motion?"

"I conclude that motion is said to be *accelerated* when it moves every moment quicker and quicker; and to be *retarded* when it moves slower and slower."

"You are perfectly right; and gravity may either act in occasioning the one or the other: our experiment at the well this morning afforded you an example of gravity in producing a regularly accelerated motion. I did not fully explain the fact at the time, because I was desirous of avoiding a too great influx of new ideas at once; we must win our way slowly and cautiously through the mazes of philosophy: I will, however, now endeavour to give you as clear an explanation as the subject will allow. — It is, I think, evident, that if, at the moment you

dropped the stone from your hand, the force of gravity could have been suspended, it would have descended to the bottom of the well with a uniform velocity; because there could have been nothing either to accelerate or retard its motion. But this was not the case, for the power of gravity was in constant operation; and, if you keep this fact in mind, you will readily understand how the velocity became accelerated: for, suppose the impulse given by gravity to the stone, during the first instant of its descent, be equal to *one*, the next instant we shall find that an additional impulse gives the stone an additional velocity equal to *one*, so that the accumulated velocity is now equal to *two*; the following instant, again, increases the velocity to *three*, and so on till the stone reaches the bottom."

Mr. Twaddleton observed, the fact might be shortly expressed by saying, that "the effects of preceding impulses must be added to subsequent velocities."

Mr. Seymour then observed that the same explanation would apply to *retarded* velocity. "If," said he, "you throw a stone perpendicularly upwards, the velocity will be as much *re-*

tarded, as it was in the other case *accelerated*, by gravity; the consequence of which is that it will be exactly the same length of time ascending that it was descending."

"I should have thought the very reverse," cried Louisa, "and that it would have fallen quicker than it rose."

"You have forgotten to take into account the force with which the stone is projected upwards, and which is destroyed by gravity before it begins to descend."

"Certainly," answered Louisa, "but the force given to a stone in throwing it upwards, cannot always be equal to the force of gravity in bringing it down again; for the force of gravity is always the same, while the force given to the stone is entirely optional. I may throw it up gently or otherwise, as I please."

"If you throw it gently," said her father, "it will not rise high, and gravity will soon bring it down again; if you throw it with violence, it will rise much higher, and gravity will be longer in bringing it back again to the ground. Suppose, for instance, that you throw it with a force that will make it rise only sixteen feet; in that case, you know it will fall in one second of

time. Now it is proved by experiment, that an impulse requisite to project a body sixteen feet upwards, will make it ascend that height in one second of time; here, then, the times of ascent and descent are equal. But, supposing it be required to throw a stone twice that height, the force must be proportionally greater. You see, then, that the impulse of projection, in throwing a body upwards, is always equal to the action of the force of gravity during its descent; and that it is the greater or less distance to which the body rises that makes these two forces balance each other."

"Thank you," dear papa, "for the pains you have taken in explaining this subject to us."

"Nay," replied Mr. Seymour, "bestow your thanks upon those to whom they are more justly due; Mrs. Marcet is entitled to the merit of this explanation; for I obtained it from her luminous 'Conversations.' Before I quit this subject, I would just observe that, when we come to the consideration of the bow and arrow, you will, by the application of the law I have endeavoured to expound, be enabled to ascertain the altitude to which your arrow may ascend, with the same facility as you discovered

the depth of the well: for, since the times of ascent and descent are equal, you have only to determine the number of seconds which intervene between the instant at which the arrow quits the bow to that at which it falls to the ground, and halving them, to make the usual calculation. — But let us proceed to another subject. Roll the ball hither, Tom; roll the ball hither, I say! you stand as if you thought it would advance to us of its own accord.”

“ I know a little better than that, too,” cried Tom; “ no body can move without the application of some force.”

“ Nor stop, either,” added Mr. Seymour, “ when it is once in motion; for matter is equally indifferent to both rest and motion.”

“ And yet, papa,” cried Louisa, “ unfortunately for your assertion, the ball stopped just now, and I am sure that no force was used to make it do so.”

“ And pray, Miss Pert, why are you so sure that no force was opposed to its progress? I begin to fear that my lesson has been thrown away upon you, or you would not, surely, have arrived at so erroneous a conclusion.”

The vicar here interposed, observing that, simple as the question might appear to those who had studied it, the fact was so contrary to every thing that passed before us, that Mr. Seymour ought not to feel any surprise at the scepticism of his daughter; he begged to remind him that the truth, apparent as it doubtless now was, lay hid for ages before the sagacity of Galileo brought it to light.

Mr. Seymour admitted the justice of this remark, and proceeded in his explanation.

“ I think,” said he, “ you will readily allow that matter cannot, in itself, possess any power of changing its condition: it can, therefore, no more destroy, than it can originate its own motion; when it is at rest, it must ever remain so, unless some force be applied that can impart to it activity; and, when once in motion, it must continue to move until some counteracting force stops it. To believe otherwise, you must suppose that matter possesses an inherent power to alter its condition, which is perfectly absurd.”

“ And yet,” said Tom, “ when I see my ball or marble stop of its own accord, how can you blame me for believing it possible?”

“ Your difficulty arises from your ignorance of the existence of certain forces which act upon the rolling ball or marble. Its progress, as it rolls along, is impeded and ultimately stopped by the rubbing, or friction, occasioned by its passage over the ground ; and this will be greater or less, according to the degree of roughness of the surface ; if it be small, the ball will continue for a longer time in motion : you must have observed, that your marble has always rolled much farther on a smooth pavement than on a rough gravel walk.”

“ Certainly,” said Tom, “ and I well remember that when we played at *ring-taw* last winter on the ice, we were obliged, for this very reason, to extend the usual boundaries.”

“ Is it not evident, then, that the motion of a body is stopped by some opposing force ; and that, if this could be entirely removed, the body would continue to move for ever ?”

Tom and Louisa both admitted the justness of the argument ; but, at the same time, expressed a deep regret that the fact was incapable of being proved by actual experiment. Mr. Seymour told them that the perpetual revolution of the earth and heavenly bodies afforded a

proof which ought to satisfy them ; and, especially, since it agreed with those views which were deduced by the aid of our reason, from the contemplation of terrestrial phenomena.

We will, therefore, with the permission of our reader, consider this point as settled, and proceed with our young philosophers to the investigation of some other topics connected with the doctrine of motion.

“ Since a body at rest,” said Mr. Seymour, “ can only be set in motion, or, when in motion, be brought to rest, by the impression of some force, it must follow, that it can only move in the direction in which such a force may act; and, moreover, that the degree of motion, or the *velocity* must, other things being equal, be in proportion to the degree of force used.”

“ Why, truly,” cried the vicar, “ my young friends must of necessity admit that fact; for the body, not having any will of its own, as you say, must needs, if it move at all, go the road it is driven.”

“ Yes,” added Mr. Seymour, “ and it must go with a velocity in proportion to the force with which it is driven.”

“Doubtless, doubtless,” cried the vicar, “you admit that also; do you not, my young friends and playmates?”

It is hardly necessary to state, that the children instantly assented to these propositions. The vicar had placed them in so clear and popular a point of view, as to be intelligible to the lowest capacities.

“With these admissions, then, my dear children,” said their father, “I shall have but little difficulty in convincing you of the truth of the other laws by which the direction of moving bodies is governed. At present, however, it is not my intention to enter upon this subject; you have some preliminary knowledge to acquire before you can understand what is termed the *Composition and Resolution of Forces*.”

“I shall not easily forget,” said Louisa, “that matter is perfectly passive, and that it can neither put itself in motion when at rest, nor stop itself when in motion.”

“This indifference to rest or motion,” replied Mr. Seymour, “has been termed the *Vis Inertiæ* of matter.”

“A very objectionable term, — a very puzzling expression,” exclaimed the vicar; —

“ to denote a mere state of passive indifference by the term *Vis*, or power, does appear to me, who have been in the habit of connecting words with ideas, as excessively absurd.”

“ I allow,” said Mr. Seymour, “ that the simple word *Inertia* would have been more correct; but we are bound to receive an expression which has been long current. I suppose, however, you know that the addition of *Vis* originated with Kepler, who, like my boy Tom, could not help thinking that the disposition of a body to maintain its motion, or state of rest, indicated something like power; but we will not waste our time upon verbal disquisitions. It is clear, that matter, at rest, resists being put in motion; the degree of that resistance is always in proportion to the degree of forced applied to put it in motion; or, to speak more philosophically, that *Action and Re-action are equal, and in opposite directions.*”

“ You, surely, do not mean to say,” exclaimed Tom, “ that if I strike my marble, the marble strikes my hand, with the same force, in return.”

“ Precisely; that is my meaning.”

“ What!” cried Louisa, “ if a man strikes another on the face with his hand, do you seri-

ously maintain, that both parties suffer the same pain?"

"Oh, no, no," said Tom, "papa can never intend to say that; I am quite sure, if it were the case, Mr. Pearson would not be so fond of boxing our ears."

Mr. Seymour answered this question, by observing that, if the hand possessed the same degree of feeling as the face, they would both suffer equally under the conflict. "If," continued he, "you strike a glass bottle with an iron hammer, the blow will be received by the hammer and the glass; and it is quite immaterial whether the hammer be moved against the bottle at rest, or the bottle be moved against the hammer at rest, yet the bottle will be broken, though the hammer be not injured: because the same blow which is sufficient to shiver the glass is not sufficient to break or injure a lump of iron. In like manner, the blow that is sufficient to pain your sensitive face, and make your ears tingle, will not occasion the least annoyance to the obtuse hand of your preceptor. The operation of this law," continued Mr. Seymour, "will be exemplified in every step of our progress. When the mar-

ble, as it rolls along, strikes any obstacle, it receives, in return, a corresponding blow, which will be found to influence its subsequent direction. The peg of the top, as it rubs on the ground, is as much influenced by the friction, as if a force were actually applied to it when in a state of rest; and when we consider the forces by which the kite is made to ascend into the air, you will learn, from the same law, the nature of that advantage which you derive from running with it."

The vicar observed that the subject of *Momentum* might be introduced, and advantageously explained, upon this occasion.

"Momentum," said Tom; "and pray what may that be?"

"It is a power," replied his father, "intimately connected with motion; and, therefore, as your friend, the vicar, justly remarks, may be very properly introduced before we quit that subject. — It is the force with which a body in motion strikes against another body."

"That," observed Tom, "must of course depend upon the velocity of the body's motion."

"Undoubtedly, my dear; the quicker a body moves, the greater must be the force with

which it would strike against another body; but we also know that the heavier a body is, the greater also will be its force; so that *momentum*, you perceive, must have a relation to both these circumstances, viz. velocity, and weight; or, to speak more correctly, *the momentum of a body is composed of its quantity of matter, multiplied by its quantity of motion*: for example, if the weight of a body be represented by the number 3, and its velocity also by 3, its *momentum* will be represented by $3 \times 3 = 9$; so that, in producing momentum, increased velocity will always compensate for deficiency of matter, and a light body may thus be made a more effective force than a heavy one, provided that its velocity be proportionally increased; thus, a small ball weighing only *two pounds*, and moving at the rate of *five hundred feet* in a second, will produce as much effect as a cannon ball of *ten pounds* in weight, provided it moved only at the rate of a *hundred feet* in the same time."

"Let me see," cried Tom, "whether I understand your statement. We must multiply, as you say, the weight by the velocity; the weight of the small ball you state at two pounds, and it travels at the rate of five hundred feet in

a second; then its momentum must be a thousand. The weight of the great ball is ten pounds, its velocity only a hundred feet, then its momentum must also be a thousand; because, in both cases, the sums multiplied into each other will give the same product."

"Exactly: and thus you perceive that the small ball becomes an exact balance to the larger one; the first making out in motion what it wanted in matter, while the latter makes out in matter what it wanted in motion. I wish you to keep this law of *Momentum* in your remembrance; upon it depends the action of all the *mechanical powers* (6), as they are termed."

"I have heard," said Louisa, "that a feather might be made to produce as much havoc as a cannon shot, if you could give it sufficient velocity."

"Unquestionably: but there is a practical difficulty in the attempt, from the resistance of the air, which increases, as you have already seen in the experiment of the paper and penny-piece (p. 64.) as the weight of a body decreases. Were it not for this resistance of the air, a hail-stone falling from the clouds would acquire such a momentum, from its accelerated velocity, as to

descend like a bullet from a gun, and destroy every thing before it ; even those genial showers which refresh us in the spring and summer months, would, without such a provision, destroy the herbage they are so well calculated to cherish. From this view of the subject of Momentum," continued Mr. Seymour, " you will easily understand why the immense battering rams, used by the ancients, in the arts of war, should have given place to cannon balls, of but a few pounds in weight. Suppose, for example, that the battering ram of Vespasian weighed 100,000 pounds, and was moved, we will admit, with such a velocity, by strength of hands, as to pass through 20 feet in one second of time ; and that this was found sufficient to demolish the walls of Jerusalem, can you tell me with what velocity a 32-pounder must move to do the same execution?"

" I will try," said Tom. " The momentum of the battering ram must be estimated by its weight, multiplied into the space passed over in a second of time ; which is 100,000 multiplied by 20 ; that will give 2,000,000. Now, if this momentum which must also be that of the cannon ball, be divided by the weight of the ball, it will

give the velocity required, which I make out to be 62,500 feet."

"Admirably calculated," said Mr. Seymour; "and I will take care, my dear Tom, that your ingenuity shall be suitably rewarded."

Mr. Twaddleton here observed, that he thought "his young friends and playmates" must have received, for that day, as much philosophy as they could conveniently carry away without fatigue. Mr. Seymour concurred in this observation; and the more readily, as the path they had to travel was rugged, and beset with difficulties. "I will, therefore," said he, "not impose any farther burthen upon them; but I will assist them in tying, into separate bundles, the materials which they have collected in their progress, in order that they may convey them away with greater ease and security. Although their labour has been considerable, I trust, at our next meeting, that its produce will be turned to their gratification, and that they will depart with a satisfaction like that which lightens the burthen of the sportsman, who, laden with the spoils of the day, returns with the cheering prospect of the feast which they are designed to furnish. — Know then, my dear children," said the affectionate parent, "that

you have, this day, been instructed in the three great Laws of Motion, viz.

- I. *That every body will continue in a state of rest, until put into motion by some external force applied to it, and if that force be single, the motion so produced will be rectilinear, i. e. in the direction of a straight line.*
- II. *Change of Motion is always proportional to the moving force impressed, and is always made in the direction of the right line in which the force acts.*
- III. *Action and Reaction are equal, in equal quantities of matter, and act in contrary directions to each other.*



CHAP. V.

A SAD ACCIDENT TURNED TO A GOOD ACCOUNT. —
 ONE EXAMPLE WORTH A HUNDRED PRECEPTS. —
 A NEW CHARACTER IN THE PERSON OF A MYST-
 ERIOUS STRANGER. — THE BANDILOR. — SOME
 GEOMETRICAL DEFINITIONS. — AN ENIGMA. —
 THE ARRIVAL OF MAJOR SNAPWELL, AND HIS
 INTERVIEW WITH THE MAIDEN LADIES OF
 OVERTON.

JUST as Mr. Seymour was, on the following morning, stepping upon the lawn, with the intention of joining his children, Rosa and Fanny both made their appearance completely drenched with water, and dripping like mermaids.

“Heyday!” exclaimed their father, “how has this misfortune happened?”

“Do not be angry, papa,” said Tom; “indeed, indeed, it was an accident. Fanny, observing the water-cart in the garden, had just begun to wheel it forward, when the water rushed over her like a wave of the sea, and, upon stopping the cart, it flew over with equal force on the opposite side, and deluged poor Rosa, who was walking in front of it.”

“ Well, well; lose no time in changing your clothes, and meet me again in half an hour.”

After the departure of the girls, Mrs. Seymour appeared on the lawn, and, advancing to her husband, placed a note in his hand, which had been just left by a female servant.

“ I perceive,” said Mr. Seymour, “ it is from that unaccountable young man, whose name is Richdale, and who has, for several months, resided at Upland Cottage in perfect seclusion.”

“ The children,” observed Mrs. Seymour, “ have frequently conversed with him in their walks, and so gentle and unembarrassed are his manners, that they are quite delighted with him, and have expressed a wish that you would invite him to the Lodge.”

“ I assure you,” replied Mr. Seymour, “ that the little I have seen of him has produced the same favourable impression upon myself, and nothing would afford me greater satisfaction than to receive him in our circle, but he declines all intercourse with the neighbourhood, and inflexibly maintains his resolution of remaining in retirement. I am fully persuaded that he is suffering under some secret

cause of dejection; for even through his transient gaiety of manner I have observed a stationary weight that oppresses the heart; and this, indeed, becomes more obvious as his countenance subsides into calm composure, just as the rocks become more visible as the water grows clearer."

"And is no one acquainted with his history?" asked Mrs. Seymour.

"No one; and when I tell you, that Miss Kitty Ryland has completely failed in her attempts to penetrate the veil of mystery by which he is surrounded, I think you will at once acknowledge the fruitlessness of any enquiry."

"There are various reports upon the subject," said Mrs. Seymour; "but they have, doubtless, had their birth in the fertility of Miss Kitty's invention."

"My dear," observed Mr. Seymour, "mystery is like a November fog, which magnifies and distorts every object that is seen through it; and I understand the maiden ladies have persuaded themselves into the belief, that this Mr. Richdale is no less than a nobleman, if not a prince of the blood, in disguise. But

the fact is, that Miss Kitty has not even a clue by which she can unravel the mystery, although, I understand, she descended to the contemptible expedient of opening a letter which was directed to him ; what were its contents I neither know nor wish to hear, but, depend upon it, they did not throw the faintest glimmer upon the subject."

As the unlucky wight, whose stomach and pockets are alike empty, will eagerly gaze through the window of a cook's shop, and sniff the savoury fumes for some time, ere he surrenders to the tantalising invitation of a scarlet and gold inscription, to enter and partake of the fare, for which he can never pay, except by a draft on his ingenuity ; so did Miss Kitty Ryland, with an epicurean appetite, in that mart of news and scandal, the village post-office, strain her watering eyes, in hopes of catching a glance at the contents of Mr. Richdale's letter, as she held it between herself and the light : but, alas ! the gratification in this case was as imperfect and unsubstantial, as in the one we have just described ; and she would probably have abandoned the attempt of appeasing her appetite, had not the motto on the seal afforded the

same encouraging invitation to our spinster, as did the aforesaid sign-board to the hero of the chop-house. The design was a violet half hidden beneath its leaves, and the motto, "*Il faut me chercher*," — "I MUST BE SOUGHT." Egad, thought Miss Kitty, I will pursue the hint; it is certainly going great lengths to break the seal, but how can Mr. Richdale discover that it was not an accident, or a mistake? Besides, the end will fully justify the means; this stranger may be some convicted felon, who has escaped the hands of justice, and may murder us all in our beds. Thus did she enter into a compromise with her easy conscience, and reconcile to herself the performance of an act, which must certainly be regarded as the greatest outrage that can be committed against the laws of civilised society. The seal was broken — the letter unfolded, — when, lo, its contents turned out to be the items of a tailor's bill! Mortified by disappointment, and unwilling to lose the advantage for which she had bartered every principle of honour, Miss Ryland instantly wrote an artful letter to the tailor, in order to cabbage some of the information which he must doubtless possess with respect to Mr.

Richdale ; but here, again, her efforts failed of success, for the man of buckram replied, that all his knowledge upon the subject of her enquiries was limited to the name and measure of his customer. But we entreat the reader's pardon ; in our willingness to illustrate the baneful curiosity of Miss Ryland, we had nearly forgotten to inform him of the contents of Mr. Richdale's note to Mr. Seymour, which ran as follows :—

“ Mr. Richdale acknowledges, with the warmest sentiments of gratitude, the kind sympathy which Mr. Seymour has so repeatedly expressed for his apparently solitary and forlorn situation ; and inspired by a confidence which such disinterested marks of attention could not fail to cherish, Mr. Richdale is induced to request Mr. Seymour's permission to pay an occasional visit to his beautiful temple of geology, and to inspect its mineralogical treasures. Circumstances of a very peculiar and private nature compel Mr. Richdale to decline all social intercourse, and to seek from philosophical pursuits that balm which not only heals the present distempers of the mind, but so invigorates it as to render it inaccessible to future attacks.”

“It is the letter of a man of feeling and refined education,” said Mr. Seymour, as he refolded the letter. “I am right: Mr. Richdale is, as I supposed, the prey of some secret grief; whatever consolation it is in my power to afford, I shall cheerfully administer;—visit the geological temple?—by all means, whenever he pleases; and I shall immediately communicate to him my permission.”

The children had, by this time, reassembled on the lawn.

“And so,” said their father, “I perceive that my philosophical lesson of yesterday has been entirely lost upon you.”

The children were unable to comprehend the meaning of this rebuke; but Mr. Seymour proceeded:—

“I trust, however, that the accident of this morning will serve to impress it more forcibly upon your memory: one example is better than a hundred precepts.”

Tom was more puzzled than ever.

“You have met with an accident; I will endeavour to convert it into a source of instruction, by showing you how the principles of natural philosophy may be brought to bear

upon the most trivial concerns of life. You learned yesterday, that a body at rest offers a resistance to any force that would put it in motion, and that, when in motion, it equally opposes a state of rest; now let us apply this law for the explanation of the accident that has just befallen you. The butt was full of water; when you attempted to wheel it forward, the water resisted the motion thus communicated to the vessel, and from its *vis inertiae*, or effort to remain at rest, rose up in a direction contrary to that in which the vessel moved, and consequently poured over; by this time, however, the mass of fluid had acquired the motion of the cart, when you suddenly stopped it, and the water in endeavouring to continue its state of motion, from the same cause that it had just before resisted it, rose up on the opposite side, and thus deluged poor Rosa."

Louisa was quite delighted with this simple and satisfactory application of philosophy, and observed, that she should not herself mind a thorough soaking, if it were afterwards rewarded by a scientific discovery.

"I will give you, then, another illustration of the same law of motion," said Mr. Seymour,

“ which, instead of explaining an accident, may, perhaps, have the effect of preventing one. If, while you are sitting quietly on your horse, the animal starts forward, you will be in danger of falling off *backward*; but if, while you are galloping along, it should stop suddenly, you will inevitably be thrown *forward* over the head of the animal.”

“ I clearly perceive,” said Louisa, “ that such would be my fate under the circumstances you state.”

“ Now, then, my dear children, since our friend the vicar cannot assist us to-day, suppose we retire into the library, and dedicate an hour or two to those less interesting, though not less important points of knowledge, with which you must necessarily become acquainted before you can comprehend the subject of the ‘ Composition and Resolution of Forces.’—I have, besides, a new toy to explain to Louisa, and an experiment to perform, in further elucidation of *vis inertiae*.”

“ And will not the vicar be here to-day?” cried Tom.

“ What should prevent his coming?” asked Louisa.

“ That excellent man, and exemplary clergyman,” said Mr. Seymour, “ always devotes Saturday to certain duties preparatory to the Sabbath ; he visits all the poor in his parish, enquires into the amount of their week’s earnings, and supplies the needy with such sums from his own purse as may be sufficient to ensure them a wholesome meal on the Sunday. He also examines the children in their catechism, and expounds the lessons of the following day.”

“ It would, indeed, be culpably selfish in us,” exclaimed Louisa, “ could we for an instant wish to divert him from so benevolent an occupation.”

The children, in compliance with their father’s wishes, cheerfully returned to the library, when Mr. Seymour presented Louisa with a BANDILOR. Most of our readers are, doubtless, acquainted with this elegant toy. It consists of two discs of wood, united to each other by a small axis, upon which a piece of string is affixed. When this string is wound round the axis, and the bandelor is suffered to run down from the hand, the end of the string being held by a loop on the fore finger, its momentum winds up the string again, and thus it will con-

tinue for any length of time to descend from, and ascend to, the hand. It affords a good example of the operation of *vis inertiae*, or what may, with equal propriety, be termed *the momentum of rotatory motion*. Its action may be compared to that of a wheel, which, running down a hill, acquires sufficient momentum to carry it up another. There are several toys which owe their operation to the same principle, of which we may particularise the windmill, whose fliers are pulled round by a string affixed to the axis of the sails. In playing with the bandilor, a certain address is required to prevent the sudden check which the toy would otherwise receive, when it arrived at the end of the string, and which would necessarily so destroy its momentum as to prevent its winding itself up again. Mr. Seymour now informed his young pupils that he had an experiment to exhibit, which would further illustrate, in a very pleasing manner, the truth of the doctrine of *vis inertiae*. He accordingly inverted a wine-glass, and placed a shilling on its foot; and, having pushed it suddenly along the table, the coin flew off, towards the operator, or in a direction opposite to that in which the glass was moving. He then replaced

the shilling, and imparted to the glass a less sudden motion ; and, when it had acquired sufficient velocity, he checked it, and the coin darted forward, leaving the glass behind it.

Louisa, upon witnessing this experiment, observed that she felt satisfied of the correctness of her father's statement, when he told her that, if the horse suddenly started forward, when she was at rest, she would be thrown off behind, and that if it should suddenly stop on the gallop, she would be precipitated over its head. The children now arranged themselves around the table, in order to consider the several mathematical figures and terms, a knowledge of which their father told them was essential to their future progress. Should any of our readers decline accompanying us through this less flowery path, they may make a short cut, and join us again at the beginning of the following chapter, although we warn such, that it is more than probable we shall start some game in our progress.

“ As to mathematical figures,” said Tom, “ if you allude to squares, circles, and figures of that description, and to parallel lines, angles, and so on, I can assure you that I am already

well acquainted with the subject ; for the work on ‘ PAPHYRO-PLASTICS ’* has fully instructed me in those particulars.”

“ If that be the case,” replied Mr. Seymour, “ you will not have any difficulty in answering my questions, but we must, nevertheless, go regularly through the subject, for the sake of your sisters, who may not be equally proficient in this elementary part of geometry : tell me, therefore, in the first place, what is meant by a *parallelogram*.”

“ A four-sided figure,” answered Tom.

“ That is true, but are there not some other conditions annexed to it ? ”

“ Yes ; its opposite sides are parallel.”

“ And what do you understand by the term *parallel* ? ”

“ Lines are said to be parallel,” said Tom, “ when they are always at the same distance from each other, and which, therefore, can never meet, though ever so far continued.”

* “ PAPHYRO-PLASTICS,” or the Art of modelling in Paper ; from the German, by Boileau. *London*, 1825. The author strongly recommends this interesting little work, as opening a new source of instructive amusement. His own children have derived from it many hours of rational recreation.

“ You are quite right. What is a *square* ?”

“ A four-sided figure, in which the sides are all equal, and its angles all right angles.”

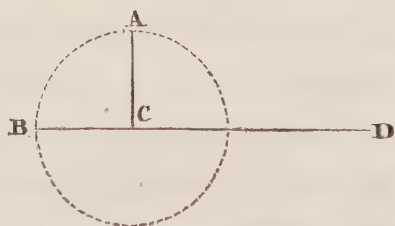
“ Good again : but let me see whether you have a correct notion of the nature of an angle.”

“ An angle is the opening formed by two lines meeting in a point.”

Mr. Seymour here acknowledged himself perfectly satisfied with his son's answers, and said that he should accordingly direct his attention more particularly to Louisa and Fanny ; and, taking his pencil, he sketched the annexed figure.

“ You perceive, Louisa,” said her father, “ that the line A C makes two angles with the line B D, viz. the angle A C D and the angle A C B ; and you perceive that these two angles are equal to each other.”

Fig. 1.



“ How can they be equal ?” cried Fanny, “ for the lines are of very different lengths.”

“ An angle, my dear girl, is not measured by the *length* of the lines, but by their *opening*.”

“ But surely,” said Louisa, “ that amounts to the same thing, for the longer the lines are, the greater must be the opening between them.”

“ Take the pair of compasses,” replied her father, “ and describe a circle around these angles, making the angular point c its centre.”

“ To what extent am I to open them ?”

“ That is quite immaterial ; you may draw your circle of any magnitude you please, provided it cuts both the lines of the angles we are about to measure. All circles, of whatever dimensions, are supposed to be divided into 360 parts, called *degrees* ; the size, but not the number, of such degrees will therefore increase with the magnitude of the circle. And since the opening of an angle is necessarily a portion of a circle, it must embrace a certain number of degrees ; and two angles are, accordingly, said to be equal, when they contain an equal number of them.”

“ Now I understand it,” said Louisa : “ as the dimensions of an angle depend upon the number of degrees contained between its lines, it evidently must be the *opening*, and not the *length* of the lines, that determines the measure of the angle.”

“ Say, rather, the *value* of the angle, for that is the usual expression : but I perceive you understand me ; tell me, therefore, how many degrees are contained in each of the two angles formed by one line falling perpendicularly on another, as in the above figure.”

“ I perceive that the two angles together are just equal to half the circle ; and, since you say that the whole circle is divided into 360 degrees, each angle must measure 90 of them, or the two together make up 180.”

“ You are quite right, and I beg you to remember that an angle of 90 degrees, is called a *right* angle, and that, when one line is perpendicular to another, it will always form, as you have just seen, a right angle on either side.”

“ I now understand,” said Louisa, “ what is meant by lines being at *right angles to each other* : but, papa,” continued she, “ what are *obtuse* and *acute* angles, of which I have so often heard you speak ?”

Mr. Seymour replied that he could better explain their nature by a drawing, than by any verbal description. “ Here,”

Fig. 2.

said he, “ is an acute angle, A ;
and here an obtuse one, B :



the former, you perceive, is one that contains less than 90 degrees ; the latter, one which contains more, and is consequently greater than a right angle."

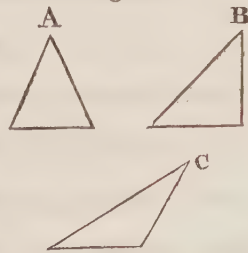
Louisa fully comprehended the explanation, and observed that she should remember, whenever an angle measured less than a *right* angle, that it was *acute*, and when more, obtuse. "But you have not yet explained to me," she continued, "the meaning of a *triangle*."

"That is a term denoting a figure of three sides, and angles. I dare say Tom can describe the several kinds of triangles."

Tom accordingly took the pencil and drew a set of figures, of which the annexed are faithful copies.

"A," said he, "is an *Equilateral* triangle; its three sides being all equal. B is a *Right-angled* triangle, having one right angle. c represents an *Obtuse-angled* triangle, it having one obtuse angle. An *Acute-angled* triangle is one in which all the three angles are acute, as represented in figure A."

Fig. 3.



“As you have succeeded so well in your explanation of a triangle, let us see whether you can describe the nature of a circle.”

“It is a round line, every part of which is equally distant from the centre.”

“And which round line,” said Mr. Seymour, “is frequently called the *circumference*. What is the diameter?”

“A straight line drawn through the centre, and terminating in the circumference on both sides.”

“And an arc?” said Mr. Seymour.

“Any portion of the circumference.”

“Now let me ask you, what name is given to a line which joins any two opposite angles of a four-sided figure?”

“The *diagonal*, papa.”

“You are quite right,” said Mr. Seymour; “and turning towards the girls, he desired them to remember that term, as they would frequently hear it mentioned during their investigation into the nature of ‘Compound Forces.’ I really think,” continued their father, “that Tom is as capable of instructing you in these elementary principles as myself; I shall therefore desire you, my dear boy, to conclude this lecture during

my absence ; remember that by teaching others we always instruct ourselves : but, before I quit you, I will give you a riddle to solve, for I well know that you all delight in an enigma."

" Indeed do we," said Louisa.

" Pray let us hear it, papa," cried Fanny.

Mr. Seymour then recited the following lines, which he had hastily composed ; the point having, no doubt, been suggested, on the instant, by the remark he had just offered.

" Here's a riddle for those who delight in their gold,
Which they p'rhaps may explain, when my story is told;
No treasure's so precious, and yet those who gain me,
Though they give me away, will always retain me !
Indeed, if they wish to increase their rich store,
By giving away, they will only add more ! !
To Fancy's quick eye, in what forms have I risen,
And Poets declare that my birth was in heaven ;
To some as a flame, as a stream, or a fountain,
To others I seem as a tower or mountain.
Should these hints not betray me, I only can say
You do not possess me, but I hope that you may."

" Why," cried Tom, " what can that be, of which the more we give away, the more we have left ?"

" Ay," added Louisa, " and that we actually *increase* the store, by *giving away* a part of it !"

“ It is some word, I think,” observed Fanny, “ do you not remember that mamma asked us what that was, from which we might take away *some*, and yet that the *whole* would remain ?”

“ To be sure,” cried Tom, “ I remember it well ; it was the word *wholesome*.”

Mr. Seymour here assured them, that the enigma they had just heard did not depend upon any verbal quibble ; and that as the object of its introduction was to instruct, rather than to puzzle them, he would explain it, and leave them to extract its moral, and profit by its application.

“ It is KNOWLEDGE,” said he.

“ ‘ *No treasure’s so precious,*’ ” repeated Louisa, “ certainly none ;—‘ *and yet those who gain me, though they give me away, will always retain me ;*’—to be sure,” added she. “ How could I have been so simple as not to have guessed it ? We can certainly impart all the knowledge we possess, and yet not lose any of it ourselves.”

“ By instructing others,” said Mr. Seymour, “ we are certain at the same time of instructing ourselves, and thus to increase our store of knowledge : let this truth be impressed upon your memory, and, after our conversations, examine

each other as to the knowledge you have gained by them ; you will thus, not only fix the facts more strongly in your recollection, but you will acquire a facility of conversing in philosophical language. I must now quit you, in order to attend to some business, which will fully occupy me until the dinner hour."

While the juvenile party is engaged in the library, and Mr. Seymour is occupied by duties, into the nature of which it is not our intention to enquire, we will amuse the reader with the account of an incident, which we shrewdly suspect may lead to some important and unexpected results.

As Miss Kitty and her satellites were engaged in the performance of those mystic rites, which we endeavoured to describe in a preceding chapter, the ceremony was abruptly interrupted by the appearance of a chariot and four, that passed along the road with luxurious speed ; and which, as Miss Kitty declared, "announced, by the dignified suavity of its roll, that the personage it conveyed was of superior rank. Those," exclaimed she, "who cannot at once distinguish such 'spirit-stirring' sounds from the discordant rattle of a plebeian chaise, deserve to

wear the ears of Midas." This extraordinary subtlety of Miss Kitty's ears is said to have been conferred upon them by those universal promoters of bodily vigour, *air* and *exercise*, of which they had received the combined advantage by the ingenious habit of listening to whispers through a certain pneumatic apparatus, familiarly termed a *keyhole*. In farther proof of the fidelity and alertness of her auditory establishment we may just state that, on passing Doseall's shop, she never failed to distinguish, by the sound of the mortar, whether the medicines under preparation were designed for the stomachs of the rich or the poor. The vicar even admitted the correctness of her discrimination, for he had himself observed that the pestle beat *dactyls* in the one case, and *spondees* in the other.

While the carriage was passing the window, the maiden companions were breathless with wonder, each catching a glance from the countenance of her neighbour, which heightened, as it were by reflection, the surprise depicted on her own.

"Overton," exclaimed Miss Noddleton, "is doubtless by this time honoured by the arrival

of some distinguished stranger; but who he is, or what may be the object of his visit, I am at a loss to divine."

"Pooh!" cried Miss Puttle; "what a fuss is here about a green carriage and four hack horses! I doubt not but that it has conveyed some visitor to the vicar; had the Seymours expected any company, I must have heard of it yesterday."

"To the vicar!" exclaimed Miss Phillis Tapps: "and pray, Miss Puttle, allow me to ask whether you ever heard of the peacock nestling with the crow?"

"Or of the eagle taking up its abode in an ivy bush?" vociferated Miss Ryland.

Conjectures were vain, and the party determined to resolve itself into a committee of enquiry. Betty, the maid-servant, was despatched to the lodge; Miss Puttle volunteered a visit to Ralph Spindle, whom Dr. Doseall employed, on the arrival of a stranger, as certain insects are said to use their "*feelers*," to discover the approach of any prey that may be likely to serve them as food; Miss Margery Noodleton was of opinion, that a visit to the several tradespeople in the village would be ad-

visible; but Miss Ryland cut this matter short, by observing that, while Miss Madge went to the "*Devil—and the Bag of Nails*," for such was the sign of the village inn, she would proceed to Annette, the vicar's housekeeper, from whom she expected to elicit much valuable information. It was finally agreed, that each should pursue such measures as she might deem most likely to ensure success, and that the party should reassemble in an hour. This plan was accordingly carried into effect, and with what success the reader must now be made acquainted.

The stranger was discovered to be a Major Snapwell, a rich and surly old bachelor, who had served in various campaigns in different parts of the globe, and received a competent number of wounds, in the defence of his king and country. His income was reported to be somewhere about three thousand a year, and that he had not any near relative to enjoy the reversion; for his nephew, whom he intended as his heir, had perished about two years before by shipwreck. The circumstances that led to this disastrous event had so affected the veteran, as to have occasioned a very serious illness, and a

consequent state of despondency, for which his physicians advised a constant change of scene; so that he had been rambling about the Continent, during the last year and a half, accompanied only by his faithful servant, Jacob Watson, who was as much attached to the major, as was ever a Newfoundland dog to his master.

Such was the information derived from Annette, the housekeeper; and no sooner had our heroines become acquainted with the particulars than they agreed, "one and all," that the major would form a most desirable addition to their snug junketings, and, in short, as Miss Puttle elegantly expressed it, that he was not a person to be "*sneezed at*." But how was a favourable introduction to this "man of war" to be accomplished? Various schemes were proposed, and as hastily abandoned, until Miss Ryland, with an air of inexpressible satisfaction, declared that she at length "had an idea."

"I will introduce myself," said she, "as a friend of his late nephew, whose memory he so highly respects, that I am quite sure he will receive with cordiality any one who bears such a claim to his notice."

“And were you then actually acquainted with his nephew?” asked Miss Puttle: “pray what was his name?”

“Henry Beacham,” replied Miss Ryland: “and as to my acquaintance with him, I confess it might have been slight; I must, however, have seen him at the house of Mrs. Tenterhook, who was hand and glove with all the fashionables in London, although I certainly do not exactly recollect the name; but what signifies it? — he is dead, and the major cannot possibly discover what might have been the extent of our acquaintance.”

With this determination, she waddled across the room, cackling like a hen who has just deposited her egg, and taking down the “*Complete Letter-Writer*,” a work which she wisely consulted in all important cases of correspondence, she sat down, and having concluded a note in her very best style of penmanship, despatched it to the major’s abode at Ivy Cottage, by her servant Betty.

“Well, Jacob,” said the major, as his trusty but asthmatic valet was leisurely buttoning on the long gaiters of his master, the morning after his arrival, “what do you hear about this vil-

lage of Overton? Are there any sociable neighbours? I like the country; it is beautiful, Jacob, and the air appears mild: it promises to be the very place to kindle the sparks of my expiring constitution, and should you, at the same time, get your broken-winded bellows mended, my vital flame might, perhaps, burn a little brighter. But tell me, what do you hear of it, Jacob?"

"Why, and please you, major, I just now met an old crony of mine, Mrs. Annette Brown, at the Devil and the Bag of Nails."

"And pray, Jacob," exclaimed the major; who taught you to speak thus irreverently of the village blacksmith?"

"The village blacksmith! Lord love you, it is the sign of the village alehouse."

"Then it is a plaguy odd one; but go on with your story."

"As I was saying, major, I met an old acquaintance who is housekeeper to Mr. Twadleton, a bachelor gentleman, and the vicar of the parish. She tells me her master is downright adored in the place: though he must needs be a queer mortal, for she says he is so fond of *antics* that he wo'n't suffer a mop or broom in his house; lest, I suppose, it should spoil the

hopping of the fleas, and put an end to the fly's rope-dance upon a cobweb."

"Jacob, Jacob, you are a wag, and had better go and offer your services to this merry parson, although I fear your asthmatic pipes would prove but a sorry accompaniment to your grotesque dancing; but pshaw — fiddlestick — stuff and nonsense — who ever heard of a vicar being fond of antics? — you are imposed upon, Jacob."

"I am sure that how Annette told me as much. Ay, and she said he had all sorts of *curosities* in his parlour; such as grinning faces, dogs with three heads, rusty swords, and I do not know what besides."

"I see it — see it all plainly," exclaimed the major; "and your story has so delighted me, that I could almost dance myself." This respectable clergyman, thought he, is, doubtless, an antiquary, a virtuoso, — what a delightful companion will he prove! and a bachelor like myself, — what *tête-à-têtes* do I anticipate!

"Jacob," exclaimed the major, "you should have said that the vicar was fond of, or to speak more correctly, devoted to *antiques*, not to *antics*."

But tell me whether there are any other agreeable persons in this village?"

"There's the squire and his family," answered the valet.

"The name, the name, Jacob?"

"Squire Seymour, and please you, major."

"Seymour, Seymour," repeated the major;

"I seem to know that name."

At this moment the servant-maid entered the room, and presented the major with the following note:—

"Miss Ryland presents her most respectful compliments to Major Snapwell, and takes the liberty to enquire whether he had not a nephew of the name of Mr. Henry Beacham; if so, Miss Ryland hopes the major will allow her the honour of an introduction into his military presence, for she had the pleasure of his acquaintance, and many have been the tears which have fallen to his memory."

"Poor Harry!" ejaculated the major, as the pathetic note fell from his hand; and then recovering himself, he asked Jacob whether he had heard of any lady in the village of the name of Ryland.

"Lord bless you, major, why she be an old

maid ; and Annette told me that she was up at the vicarage almost as soon as we came to the village, asking a thousand questions about you."

" No matter, no matter ; if she knew poor Harry I must see her."

" But you wo'n't be glad to *hear* her," replied Jacob, " for she has a rare tongue of her own. A man of the name of Hopkins told me at the '*Devil*,' that Overton is famous for a nest of these old maids."

" Old maids !" exclaimed the major, with a shudder. The reader must be here informed, that the gallant officer, like many elderly bachelors, entertained a sort of constitutional antipathy to this neglected class of the tender sex : although, we must confess, that such a feeling is highly ungenerous in a set of men who contribute by their own selfish conduct to produce the very evil they so loudly deprecate ; nor is the feeling to be readily explained, unless we admit that communities, like individuals, hate and persecute those whom they have injured. The major, however, sat down and despatched the following answer :—

" Major Snapwell returns the compliments of Miss Ryland, and begs leave to observe that he

is a man of no ceremony, and cannot endure it in his presence; if, therefore, Miss Ryland will, without any ceremony, honour him with a call, the major will be proud in receiving her at Ivy Cottage."

The reader will readily believe that Miss Kitty lost no time in availing herself of so courteous an invitation; she accordingly dressed her person in her best attire, and proceeded on the following morning, with her friend Miss Noodleton, to pay her respects to the revered uncle of "poor Mr. Beacham."

"The Major Snapwell, I presume," said Miss Kitty, as she glided into the presence of the gallant commander.

"The same, madam, at your service. — Jacob, place some chairs."

"The military," replied the visitor, "are, as we well know, ever at the service of the ladies; allow me to present to you my worthy and excellent friend and companion, Miss Margery Noodleton."

"I fear," exclaimed the major, "that the compliment you are so graciously inclined to bestow upon the military character, will scarcely apply to the humble member of the profession

whom you so highly honour by your condescension."

What a charming person! mentally ejaculated Miss Ryland.

"I am, madam, an old bachelor: 'an odd volume of a set of books,' as Franklin would say; or 'the odd half of a pair of scissors, which, although it cannot cut any thing, may possibly serve to scrape a trencher.'" — But be seated, ladies; pray be seated. I am a man of no ceremony, and never suffer any in my presence."

"Not even the *ceremony* of matrimony," observed Miss Ryland, with a significant smile."

"True, madam, true. My business has been with matches of a very different description — *quick* matches, madam; *quick* matches, and *balls* have been my delight."

"Well am I assured, most gallant major, that the military character is ardent and precipitous; love at first sight," added she, with a deep sigh, "and short courtships have ever met with powerful advocates in your profession. I wonder not, therefore, at your partiality to balls, which as you justly remark, have lighted

many a match ; and such, according to my experience, have generally been quick matches."

" Why zounds ! madam," ejaculated the major, as he started from his seat, " we are skirmishing in the dark, — you misunderstand me ; I speak of the matches of war, not of love, and of the balls of cannon, not of Almack's ; although I am ready to admit that in one respect these different matches should agree — in not hanging fire, madam ; and yet," added the major, lowering his voice, as if suddenly affected by some painful reflection, " my precepts and practice have strangely differed.— Harry ! Harry ! could thy noble spirit be conscious of the remorse of thy broken-hearted uncle ! — but, ladies, I entreat your pardon."

At this allusion to the memory of the nephew, Miss Kitty unfurled her white flag, and was preparing to display some other signals of distress ; which the major no sooner perceived, than in a hurried manner he begged the ladies to abstain from any allusion to the agonising subject.

For reasons, which the reader will not have much difficulty in appreciating, these few words removed a load of anxiety from the breast of

Miss Kitty. Her feelings might be compared to those of the mariner, whose ship suddenly veers round by a change of wind, at the very moment it approaches a rocky lee shore. The conversation immediately took a new direction; the ladies enumerated the several families in the neighbourhood; descanted upon the pride of the Seymours, the eccentricities of the vicar, the mysterious conduct of Mr. Richdale, the wonderful cures of Dr. Doseall, the curious inventions of Will Snaffle, the critical acumen of Jerry Styles; in short, the poor major was assailed by a battery more incessant in its operations than that which opened upon him at the siege of Badajoz; at length, however, the fire began to slacken, the assailants having discovered that the citadel was not to be taken by assault. Upon their departure, Jacob was angrily summoned into the major's presence, in order to receive the explosions of indignation with which his master was doubly charged; and who, upon such occasions, employed the faithful servant, as he had formerly used a target when he had no better object to fire at.

“May the old one fly away with thee, and toss thee in his bag of nails!” exclaimed the major;

“ all this comes of your chattering at the public-house. That ‘woman’s tongue runs as fast, and with as much clattering, as a dog with an empty canister at its tail : but take care that I am not exposed to a repetition of this annoyance. Should the spinsters *honour* me with another call, inform them that I am from home ; or tie up the knocker, and tell them I am sick, dead, buried ; say any thing, but, for mercy’s sake, spare me from such another visitation.”



CHAP. VI.

ELASTICITY. — SPRINGS. — THE GAME OF “RICOCHET,” OR DUCK AND DRAKE. — REFLECTED MOTION EXEMPLIFIED IN THE REBOUND OF A BALL. — ANIMALS THAT LEAP BY MEANS OF AN ELASTIC APPARATUS. — MR. TWADDLETON’S ARRIVAL. — A NEW SPECIES OF PUFFING, BY WHICH THE VICAR IS MADE TO CHANGE COUNTERTENANCE. — THE DANCING BALLS. — THE PEASHOOTER. — A FIGURE THAT DANCES ON A FOUNTAIN. — COMPOUND FORCES.

EARLY on Monday morning did the young group assemble in the library; they expected to have met the vicar, in order to resume those philosophical recreations in which they took so

much delight; but the breakfast had been concluded, and yet Mr. Twaddleton was still absent.

“What can have detained our worthy vicar?” exclaimed Mrs. Seymour; “he promised on Friday that he would pay us a very early visit this morning.”

“At present,” observed Mr. Seymour, “we can, fortunately, proceed without his assistance; for there yet remains a property of matter which must engage our attention.”

“And what may that be?” asked Louisa.

“ELASTICITY,” replied her father; “and I wish to hear whether Tom can explain to us the meaning of the term.”

Tom very well knew what was meant by Elasticity; but he was like many a merchant with a bill of exchange, who, although well acquainted with its value, has not sufficient small change to cash it. Tom wanted words to enable him to furnish a clear definition; his father, therefore, kindly relieved his embarrassment, by informing him that “it was a property inherent in certain bodies, by which they possessed a disposition to have their form altered by force or pressure, and to recover it on the re-

moval of that pressure, throwing off the striking body with some degree of force; for example," continued he, "the cane, which I hold in my hand, can be bent to a certain extent, and then, if I let it go, it will immediately return to its former condition with considerable force."

Louisa enquired whether bending and pressing upon a body were the same thing. Mr. Seymour replied that the form of an elastic body might be altered either by compression, or distention, and that *bending* was, in fact, only a combination of these two methods: "for," said he, "when a straight body, like my cane, is bent, those particles of it which are on the one side are compressed, while those on the other are distended. But let us proceed with the subject. I have said that elastic bodies, on returning to their original form, throw off the striking body with some degree of force. I have here," continued Mr. Seymour, taking out of his pocket a wooden image of a cat, "a toy which I intend as a gift to John, it will serve to illustrate our subject. The tail you perceive is movable, one of its ends being tied to a piece of catgut, which is a highly elastic substance. When I bend the tail under the body of the

animal, I necessarily twist the string; and, by pressing the other end of the wooden tail upon a piece of wax, I can retain it for a few seconds in that situation."

Mr. Seymour having fixed the tail in the manner above described, placed the wooden image on the ground, when in a few seconds it suddenly sprang forward, to the great delight of the younger children.

"Can you explain this action?" asked Mr. Seymour.

"The wax," answered Tom, "was incapable of holding the end of the tail longer than a few seconds; and as soon as it was let loose, the elasticity of the catgut enabled it to return to its former condition; in doing which, the tail struck with force against the ground, which threw off the body of the cat, and produced the leap."

"Very well explained; and you, no doubt, will readily perceive that the operation of steel springs depends upon the same principle of elasticity: a piece of wire or steel, coiled up, may be made to set a machine in motion, by the endeavour it makes to unbend itself. This is the principle of the spring in a watch: when

our watches are what is termed *down*, this steel has uncoiled itself; and the operation of winding them up, is nothing more than that of bending it again for action. (6) If the elasticity of a body be *perfect*," added Mr. Seymour, "it will restore itself with a force equal to that with which it was compressed. As I have given John a toy, it is but fair that I should reward you, Tom: open that box, and examine the gift which it contains."

Tom received the present from his father, and proceeded to open the lid; when, to his great astonishment, the figure of an old witch suddenly sprang upwards. Mr. Seymour explained its mechanism, by stating "that the figure contained a wire coiled up, like a cork screw, and which, upon the removal of the pressure of the lid which confined it, immediately regained its original form." (7)

Tom enquired what kind of bodies was most elastic. He was informed that the air was the most elastic of all known substances; and had, for that reason, been distinguished by the name of an *elastic* fluid. Hard bodies were so in the next degree; while soft substances which easily retain impressions, such as clay, wax, &c.,

might be considered as possessing but little elasticity.

“ I should have thought,” said Louisa, “ that neither clay nor wax had possessed *any* elasticity.”

“ My love, we know not any bodies that are absolutely, or perfectly, either hard, soft, or elastic ; since all partake of these properties, more or less, in some intermediate degree. Liquids are certainly the least elastic of all bodies ; and, until lately, water was regarded as being perfectly inelastic : but recent experiments have shown it capable of compression, and of restoring itself to its original bulk, as soon as the pressure is removed ; it must therefore possess some elasticity. Indeed,” said Mr. Seymour, “ we might have anticipated such a result, from the effects which present themselves in the well-known game of ‘ *Ricochet*,’ or *Duck and Drake*. ”

“ *Duck and Drake !* ” exclaimed Louisa ; “ for goodness’ sake, what can that game be ? ”

“ I dare say your brother will not have any difficulty in explaining it to you.”

Tom informed her that it was a game in which any number of boys threw a stone, or a

flat piece of tile into the water; and that he, whose stone rebounded the greatest number of times, was the conqueror."

"It is a very ancient game," said Mr. Seymour, "and, had the vicar been present, we should have heard a learned disquisition upon it; as he, however, is unfortunately absent, I must tell you all I know upon the subject. It was called by the Greeks *Epostrakismos**, and was anciently played with flat shells. Now it is evident that the water must possess some degree of elasticity, or the stone could not rebound (8); but I shall have occasion to revert to the subject hereafter."

"And are my marbles elastic?" asked Tom.

"Undoubtedly; but not to the same extent as your ball. There," said Mr. Seymour, throwing his ball against the wall, "see how it rebounds."

"The return of the ball," observed Tom, "was, I suppose, owing to its elasticity; and I now understand why one filled with air rebounds so much better than one stuffed with bran or wool?"

* Pollux, lib. ix. c. 7.

“ You are quite right ; and the return of the ball, after having struck the wall, affords an example of what is termed *reflected* motion ; upon which I shall have to remark, when we come to the interesting subject of ‘ Compound Forces :’ but, at present, my only wish is to render the property of elasticity intelligible to you. It is a force of very extensive application ; there is scarcely a machine, wherein the elasticity of one or more solids is not essentially concerned. Nature, also, avails herself of this property to accomplish many of her purposes. Fleas are enabled to jump two hundred times the height of their own bodies, by means of a springy membrane, easily visible by a microscope ; and the regular dispersion and sowing of the seeds of several plants is effected by a spring, which is wound sometimes round the outside, and at others round the inside, of the case in which the seeds are contained.” (9)

“ I suppose,” said Tom, “ that it is by some such spring shrimps are enabled to leap to the tops of cataracts, as I have read in my work on Natural History.”

“ Many species of fish are thus enabled to leap, by bending their bodies strongly, and then

suddenly unbending them with an elastic spring ; and the long-tailed crayfish and the common shrimp, leap by extending their tails, after they have been bent under their bodies."

Mr. Seymour had just concluded the above discourse, when the door opened, and the vicar entered the study.

" My dear friends," exclaimed Mr. Twadleton, " I have been most provokingly detained by the maiden ladies, or I should have been with you, as I had promised, at a much earlier hour : upon my word, Mr. Seymour, their tongues are like aspen leaves, never at rest."

" You may then congratulate yourself," observed Mr. Seymour, " that you have escaped before the *fall of the leaf* : but what has put them in motion ? some fresh *breeze*, I suppose."

" They have been amusing me," replied the vicar, " with the birth, parentage, education, and adventures of a Major Snapwell, who has just taken up his abode at Ivy Cottage. After this topic was discussed, they reverted to the old story of village education, and told me, in pretty *broad* terms, that my contumacy should be visited by all the evils their spleen could devise."

“ Their discourse then,” said Mr. Seymour, “ was just as *broad as it was long*.”

“ What ! at your old vice again ?”

“ Well ; I shall, doubtless, soon meet with my punishment ; I am sure to receive *poetical* justice from your hands ; a *line* at this moment hangs over me ; hey, my friend, do you understand me ?”

Mr. Twaddleton either did not comprehend, or would not notice this last *jeu d'esprit*, but proceeded to state that he had no sooner escaped from the aforesaid quicksands, than he encountered *Polyphemus*. Our readers may, perhaps, wonder who this *Polyphemus* could have been ; we must therefore inform them that Mr. Twaddleton, whose ideas were always tintured with classical colouring, had bestowed this appellation upon the renowned Dr. Doseall, because, as he said, his practice was, like the Cyclops, *strong but blind* ; and Mr. Seymour declared that the similitude was even more perfect than the vicar had contemplated, for he observed that he certainly fattened upon the unhappy victims who fell within his clutches. With all our respect for the liberality of Mr. Seymour, and the kind-heartedness of the vicar,

we must, in justice to this respectable son of Esculapius, express our disapprobation at so unprovoked a sarcasm. We admit that Dr. Doseall, after the example of other celebrated physicians, had one sovereign remedy, which he administered in every disease ; but what of that ? he was often successful in his cures, that is to say, his patients sometimes recovered *after* they had taken his physic, and is not that the test conventionally received in proof of the skill or ignorance of greater physicians than Dr. Doseall ? Nor can we persuade ourselves into the belief that a doctor who faithfully adheres to one single remedy is less likely to be right, than those restless spirits who are eternally coquetting with all the preparations of the Pharmacopœia, without ever remaining steady to any one of them. It has been truly remarked that the clock which stands still, and points steadfastly in one direction, is certain of being right twice in the twenty-four hours, while others may keep going continually, and as continually going wrong. Being ourselves no doctors, we merely throw out this hint for the consideration of those who are learned in such

matters : but we beg the pardon of our readers for this digression.

“ Well,” said Mr. Seymour, “ I am, at all events, rejoiced to see our *Trojan* in safety, after such perilous adventures ; and I hope that he is now prepared to set sail again with us, on a new voyage of discovery. I have been engaged,” continued he, “ in explaining the nature of elasticity, and I now propose to exhibit an experiment, in farther illustration of the subject. Here,” cried Mr. Seymour, as he removed a small piece of apparatus from a box which stood on the table, “ is a toy, at which the sternest philosopher, nay even Heraclitus of weeping memory, could not refrain from laughing.”

He then displayed a small ball of Indian rubber, on which was painted an exact resemblance of the worthy vicar, executed under the direction of Mr. Seymour, by that inimitable artist, George Cruikshank. The ball was connected with an air syringe, by which it was easily distended. It gradually increased in magnitude as the inflation proceeded, and the countenance of the vicar progressively enlarged to the size of the full moon, without the least alteration in the character or expression of its features.

“ I declare,” cried Mr. Seymour, “ the vicar *improves upon acquaintance.*”

“ True,” replied Mrs. Seymour, “ but not without the aid of your *puffing.*”

The countenance had, after a short time, swelled to ten times its original dimensions; the children deafened Mr. Seymour with their shouts, and the good-humoured clergyman was actually convulsed with laughter. Mr. Seymour now turned the stop-cock; the bladder became smaller and smaller, and the features underwent a corresponding diminution, until they once again assumed their original dimensions.

“ You perceive, my dear sir,” said Mr. Seymour, “ that I make you *look small* again.”

“ That,” replied the vicar, “ is by no means an unusual effect of your jokes.”

“ There was one point in the exhibition, faithfully characteristic of the vicar,” observed Mrs. Seymour.

“ And pray, madam, may I be permitted to enquire what that may have been?”

“ Its *elasticity*,” replied Mrs. Seymour; “ of which we must all acknowledge that you possess a no small proportion.”

“ Now Tom,” exclaimed his father, “ explain the nature of the exhibition you have just witnessed.”

“ The bladder was highly elastic, it therefore yielded to the pressure of the air, and became distended. As soon, however, as the pressure was removed, the air was driven out with force, and the particles of the Indian rubber returned to their former condition. But I observed one circumstance which I do not exactly understand,” said Tom; “ when you first turned the stop-cock, the air rushed out with great violence, and the ball diminished very rapidly; but it gradually slackened, until, at length, the bladder could scarcely be seen to contract.”

“ I rejoice to find that you were so observant,” said his father. “ The effect you noticed depended upon a general law of elasticity: elastic bodies, in the recovery of their form from a state of compression, after the removal of the compressing force, exert a greater power at first than at last, so that the whole progress of restoration is a *retarded motion*.

“ I will now,” continued Mr. Seymour, “ exhibit an experiment in illustration of *momentum*;

you, no doubt, remember that velocity makes up for weight; although, therefore, a fluid, as air or water, may in a state of quiescence be unable to support a body, yet, by giving it a certain velocity, it may acquire a sustaining power. I have, here, several gilded pith-balls, through one of which I have run two pins, at right angles to each other; the naked points, you perceive, are defended with sealing-wax, to prevent any mischief that might arise from their accidentally coming into contact with your face. By means of this brass tube (the stem of a tobacco-pipe will answer the same purpose,) I shall produce a current of air by my breath, and you will observe that the little ball will continue to dance, as if unsupported.”

Mr. Seymour then placed the pith-ball at the end of the pipe, and, inserting its other extremity in his mouth, blew out the ball, which immediately rose in the air, and continued to float about for several seconds; he then drew in his breath, and caught it with much address, on one of its points; and in this manner, alternately floating and catching it, did he continue to delight the wondering group for several minutes.

Tom received the tube and ball from the hand of his father, and soon succeeded in playing with it. Observe, gentle reader, the address with which the boy manages it.



“This reminds me of my pea-shooter,” said Tom, as he removed the tube from his mouth, “with which I have often shot a pea across the play-ground.”

“Exactly; and you will now understand the nature of the force by which your pea was projected. The air blown from the lungs, gains such momentum from the contracted channel in which it flows, as to impart considerable velocity to the pea placed within the influence of its current.”

Mrs. Seymour observed that she had lately read in Waterton’s *Wanderings in South America*, a very interesting account of the Indian blow-pipe, which the natives of Guiana employ as an engine for projecting their poisoned arrows, and which owes its power to the principle of which Mr. Seymour had just spoken, and its unerring accuracy to the skilful address of the Indian who uses it. (10)

“It is upon this same principle,” exclaimed Mr. Twaddleton, “that some wild speculators have proposed to propel passengers and packages along a tube, by means of a blast of air.”

“I have read an account of the scheme,” said Mr. Seymour; “the patentee proposes to produce a current of air, by means of a vacuum, and to avail himself of its momentum.”

“I suppose you know,” said the vicar, “that the scheme originated with Tom Plank, and is one of the first fruits of the Overton Institute. He is now engaged in farther improvements in his plan, and is attempting to condense atmospheric air into a liquid, so that he may disengage any quantity from a vessel, to be contrived for the purpose; and thus, like Æolus, to temper the wind according to the duty it may have to perform.”

“We will now proceed to the orchard,” said Mr. Seymour. “I have another pleasing exhibition for the children.”

The party accordingly left the lodge, and when they had arrived at the fountain, their father produced a small wooden figure of which the annexed is a sketch. Within its base was

fixed a hollow sphere, or ball of thin copper, which, when properly adjusted on a fountain, or *jet d'eau*, was sustained by the momentum produced by the velocity of the stream; so that the whole figure was balanced, and made to dance on the fountain, as the pith-ball had been made to play in the current of air.



The children were much gratified at witnessing so curious an exhibition. Mr. Twaddleton laughed heartily at the ludicrous effect it produced, and observed that, although he had never before seen the experiment, he had frequently heard of it; and he added, that he understood it to be a very common toy in Germany and Holland.

Mr. Seymour now informed his children that, at present, he had no other experiments in view; he therefore proposed that the party should return, and commence their enquiries into the nature of “Compound Forces.”

“ If that be your arrangement,” said Mr. Twaddleton, “ I shall, with your permission, depart; for I am desirous of paying my respects to Major Snapwell: as vicar of the parish, I always consider it a duty to call upon every respectable stranger. When, however, you require my services, as an antiquary, remember that I shall be at your command.”

The vicar accordingly proceeded to Ivy Cottage; while the Seymour family returned to the library, in order to recommence their studies.

The party having assembled around the table, Mr. Seymour commenced his lecture by reminding his young auditors, that the motion of a body actuated by a single force was always in a right line, in the direction in which it received the impulse.

“ Do you mean to say, papa, that a single force can never make a body move round, or in a crooked direction; if so, how does it happen that my marble or ball will frequently run along the ground in a curved direction?”

“ Ay,” added Louisa; “ and what makes your hoop so constantly run on one side?”

“ Depend upon it, my dear, whenever the direction of a moving body deviates from a

straight line, it has been influenced by some second force."

"Then I suppose that, whenever my marble runs in a curved line, there must be some second force to produce the effect."

"Undoubtedly; the inequality of the ground may give it a new direction; which, when combined with the original force which it received from your hand, will fully explain the apparent irregularity of its course. It is to the consideration of such compound motion that I am now desirous of directing your attention: the subject is termed the 'COMPOSITION OF FORCES.' Here is a block of wood with two strings, as you may perceive, affixed to it: do you take hold of one of these strings, Louisa; and you, Tom, of the other. — That is right. — Now place the block at one of the corners or *angles* of the table; and while Tom draws it along one of its sides, do you, Louisa, at the same time, draw it along the other."

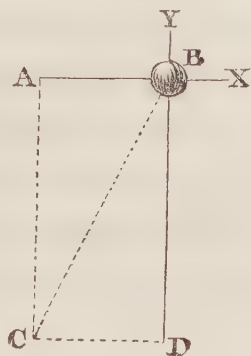
The children obeyed their father's directions.

"See!" said Mr. Seymour; "the block obeys neither of the strings, but picks out, for itself, a path which is intermediate. Can you tell me, Tom, the exact direction which it takes?"

“ If, papa, we consider this table as a parallelogram, I should say that the block described the diagonal.”

“ Well said, my boy ; the ablest mathematician could not have given a more correct answer. The block was actuated by two forces at the same time ; and, since it could not move in two directions at once, it moved under the *compound* force, in a mean or diagonal direction, proportioned to the influence of the joint forces acting upon it. You will, therefore, be pleased to remember, it is a general law, that where a body is actuated by two forces, at the same time, whose directions are inclined to each other, at any angle whatever, it will not obey either of them, but move along the diagonal. In determining, therefore, the course which a body will describe under the influence of two such forces, we have nothing more to do than to draw lines which show the direction and quantity of the two forces, and then to complete the parallelogram by parallel lines, and its diagonal will be the path of the body. I have here a diagram which

Fig. 4.



may render the subject more intelligible. Suppose the ball *B* were, at the same moment, struck by two forces *x* and *y* in the directions *B A* and *B D*. It is evident that the ball would not obey either of such forces, but would move along the oblique or diagonal line *B c*."

"But," said Tom, "why have you drawn the line *B D* so much longer than *B A*?"

"I am glad you have asked that question. Lines are intended, not only to represent the direction, but the *momenta*, or quantities of the forces; the line *B D* is, as you observe, twice as long as *B A*; it consequently denotes that the force *y* acting in the direction *B D*, is twice as great as the force *x* acting in the direction *B A*. Having learned the direction which the body will take when influenced by joint forces of this kind, can you tell me the relative time which it would require for the performance of its diagonal journey?"

Tom hesitated; and Mr. Seymour relieved his embarrassment by informing him, that it would pass along the diagonal in exactly the same space of time that it would have required to traverse either of the sides of the parallelogram, had but one force been applied. Thus,

the ball *B* would reach *c* in the same time that the force *x* would have sent it to *A*, or the force *y* to *D*. “I will endeavour to prove this fact beyond all doubt. It is, I think, evident, that the force which acts in the direction *B A* can neither accelerate nor retard the approach of the body to the line *D c*, which is parallel to it; hence it will arrive at *c* in the same time that it would have done had no motion been communicated to it in the direction *B A*. In like manner, the motion in the direction *B D* can neither make the body approach to nor recede from *A c*; and it therefore follows that, in consequence of the two motions, the body will be found both in *A c* and *c D*, and will therefore be found in *c*, the point of intersection.”

Louisa seemed to express by her looks the irksomeness of such demonstrations; and which did not pass unobserved.

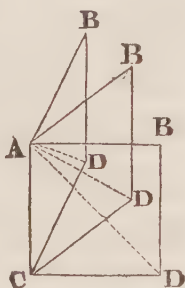
“This may appear tedious and uninteresting,” said Mr. Seymour; “but the information is absolutely essential to our future progress; if you would reap, you must sow.”

Tom and Louisa both expressed themselves

willing to receive whatever instruction their father might consider necessary, and they farther declared that they understood the demonstration he had just offered them.

“Is it not then evident,” proceeded Mr. Seymour, “that the composition of forces must always be attended with loss of power; since the diagonal of a parallelogram can never, under any circumstances, be equal to two of its sides: and is it not also evident that the length of the diagonal must diminish as the angles of the sides increase: so that the more acute the angle at which the forces act, the less must be the loss by composition? But I shall be better able to explain this law by a diagram. If BA , AC be the sides of a parallelogram, representing the direction of two forces, and AD the diagonal path of the body, is it not evident that the line AD will shorten as the angle BAC diminishes?”

Fig. 5.



“We see that at once,” cried Tom, “from the diagram before us.”

“Then we will proceed to another fact connected with the same subject. Look at this

diagram; is not the diagonal AD common to both the parallelograms inscribed about it, viz. of $ABCD$, and $AEDF$?"

"To be sure it is."

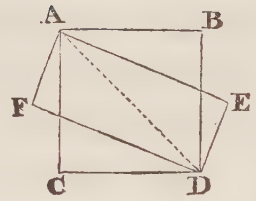
"Then it is equally clear that a body may be made to traverse the same path AD , by any pair of forces represented by the adjacent sides of either of such parallelograms."

"Undoubtedly."

"I request you to keep that fact in your recollection. We will now suspend our studies until to-morrow."

"I approve of your determination," said Mrs. Seymour, who had been an attentive auditor during this lesson; "your birds are, as yet, scarcely fledged, and they will make greater advances by short flights, frequently repeated, than by uninterrupted progression."

Fig. 6.



CHAP. VII.

THE VICAR'S INTERVIEW WITH MAJOR SNAPWELL.
 —THE RESOLUTION OF FORCES. — ROTATORY
 MOTION.—THE SLING.—THE CENTRIFUGAL AND
 CENTRIPETAL FORCES.—THEORY OF PROJECTILES.
 — A GEOLOGICAL CONVERSATION BETWEEN
 MR. SEYMOUR AND THE VICAR.

OUR readers will remember that Mr. Twaddleton left the party at the lodge, in order to pay his respects to Major Snapwell. As the circumstances developed during their interview are intimately connected with our story, we shall relate, as nearly as we are able, the conversation which took place upon that occasion.

“ Mr. Twaddleton,” said the major, as he advanced towards the door to meet his visitor, “ I feel myself obliged and honoured by your kind attention. As a perfect stranger I could scarcely have expected this civility; but your village, surrounded as it is with all the softer charms of nature, is calculated to impress the hearts of its inhabitants with a kindred gentle-

ness. Am I rightly informed that the neighbourhood of Overton is no less healthy than it is beautiful?"

"So says Dr. Doseall," observed the vicar; "and upon this point I am not disposed to question either his judgment or sincerity."

"The inhabitants," observed the major, "are doubtless much attached to their country?"

"Proverbially so; never was Ulysses more attached to his Ithaca."

"Nor the apples of the Hesperides," added the major, with a smile, "more vigilantly guarded, than are the blooming orchards of Overton. I had scarcely taken off my travelling dress, before I encountered a brace of she-dragons, — excuse the bluntness of an old soldier, — to enquire into the circumstances and object of my intrusion."

"She-dragons! — Intrusion!! — Why, what can you possibly mean, major?"

"In plain terms, then, I received a visit from a couple of inquisitive, and I must add, impertinent, old maids."

"Miss Ryland," I presume.

"Yes; and a Miss Noo — Noodle — Noo-dleton, that was the name of her companion."

“ And may I ask what might have been the topic of their discourse, as it seems to have so greatly disparaged them in your opinion ?”

“ Every thing and nothing : their tongues were like race-horses, which always run the faster the less weight they carry. But I crave your pardon ; I am, perhaps, wrong in forming a prejudice from so transient an acquaintance, and still more culpable in giving expression to it : but rather than suffer another half hour in their presence, I would willingly ride bodkin in a hack chaise for a week in the dog days, with two of the fattest fish-wives in Billingsgate. But sit thee down ; I am a man of no ceremony, as you doubtless perceive ; I hate it, and never suffer it in my presence. With this understanding, I am sure that you will not take offence at a question to which I am anxious you should give me an answer. Are you, my dear sir, as I have just reasons for supposing, an ANTIQUARY ?”

“ I am undoubtedly attached to pursuits which might have favoured such a report.”

“ I thought so ; I guessed as much : then give me your hand,” exclaimed the major, as he rose from his seat and approached the vicar, “ give me your hand ; we must be friends and

associates: if there be a pursuit on earth to which I am devotedly attached, it is to that of antiquities; and, let me add, that if there be a literary character to whom the professor of arms ought to feel superior gratitude, it is to the antiquary. How many victories, what valiant deeds, must have perished in the memory of mankind, but for the kind offices of the virtuoso! under whose vivifying touch the laurels of the victor have bloomed with renovated vigour: and when the scythe of time has left them to wither, and to be scattered on the wings of the wind, he collects their remains, and piously deposits them in a splendid mausoleum, in order to preserve them to the latest posterity."

It were difficult to say, whether astonishment at the major's warmth, delight at the congenial sentiments he had expressed, or admiration at the language in which they had been conveyed, was the feeling predominant in the vicar's mind; nor do we deem it necessary to enquire; suffice it to say that, from the conversation of a few minutes, these two gentlemen felt incited to a mutual regard, by sympathy and congeniality of soul; so true is it that, while we may be strangers with the companions of years, we

may become friends with the strangers of yesterday !

“ Major Snapwell,” said the vicar, “ your friendship will greatly add to my happiness, by extending the sphere of my literary resources. When may I expect the pleasure of your company at the vicarage ? I am impatient to show you a few dainty morsels of *vertù*, which I am confident will delight you. My collection of medals, as far as it goes, is respectable, and I think you will approve of the chronological arrangement which I have adopted.”

“ I was myself formerly a collector of coins,” said the major, “ and entertained a serious intention of publishing a work on the money of ancient nations. I have always maintained, that the earliest medium of exchange was cattle : hence I conceive the origin of the word *opes* or *oves*, the substitution of the *p* for the *v* easily admits of explanation ; hence, too, the derivation of *pecunia* from *pecus* ; and, probably, the proverb, *Bos in lingua*, so commonly applied to one who hesitates to speak truth, from the influence of a bribe, may receive the same satisfactory explanation.”

“ May not these expressions relate to the figures of cattle formerly stamped upon money ? ”

“ I admit that, in later times, the object was exchanged for its symbol; but we will talk over this matter hereafter. As we are, however, upon this subject, do tell me, vicar, your opinion respecting the Apamean medal: do you agree with Falconerius, who first broached the doctrine; and with Echel, who has so ably supported it in his work ‘ *De Doctrina Nummorum veterum*,’ in considering it as referring to the tradition of Noah’s Deluge? I honestly confess, that I incline to the Deucalion hypothesis, and agree with Dean Miller and Judge Barrington.”

“ The authority of Abbé Echel,” replied the vicar, with much solemnity, “ is of overpowering weight; besides, what say you to the Greek letters N O* inscribed upon it; that circumstance alone ought to silence all scepticism: are you not convinced by such evidence?”

“ I must say, N O,” replied the major with a smile.

“ My dear sir,” exclaimed the vicar, “ I hope you are not a punster.”

“ To that I again reply, N O. I am not a Johnian, vicar.”

The vicar expressed himself greatly relieved by this declaration ; and begged him to say for what reason the N O did not convince him : “ besides,” added he, “ some antiquaries go so far as to add the E.* ”

“ My difficulty is simply this,” that a reference both by symbols and letters to the Jewish history and belief, on a Greek coin, struck in the reign of Severus, at a town of Phrygia, is a case, I believe, without any parallel in the history of Greece.”

“ If you are thus sceptical, I fear that you will throw doubts over my silver medal, which was dug up in company with some Roman coins in Surrey. It presents a fine head of our Saviour, and has on its reverse a Hebrew inscription, which signifies that ‘ he came to save man’s soul from death.’ ”

“ It is evidently a counterfeit,” said the major, “ the antiquary acknowledges not any medal with the head of our Saviour.”

“ A counterfeit ! ” exclaimed the vicar, “ a counterfeit, do you say ? Let me tell you, sir, that a person who can thus pronounce judgment upon a coin, which he has neither seen nor sounded,

* E.

acts not the part of a discreet antiquary, who will not so much as decide upon the genuine nature of an *æruugo*, until he has cautiously tasted it. Like another Philander, you may ridicule my credulity, but I am one of those who acknowledge as much difference between the relish of ancient and modern brass, as between an apple and a turnip. A counterfeit, forsooth! — no, no, it is a genuine medal, struck by a Grecian artist at the crucifixion, and is, doubtless, a correct portrait of my Divine Master.”

“ I am sorry,” said the major, “ that I should have unintentionally excited your indignation; I merely wished to intimate, that your antiquarian view of the medal would require some very heavy concessions: but let us drop the subject for the present; and, in order to divert our conversation into a different channel, do pray tell me the origin and import of the extraordinary sign of your village inn — *The Devil and the Bag of Nails!* The Devil I could swallow, as well as any soldier in the service of King George, but those confounded nails have been sticking in my throat ever since my servant Jacob informed me of the circumstance. Before, however, you communicate

your explanation of this matter, I should wish you to hear the opinion which I have formed upon it. You must know, then, that I have ever regarded the Devil as the legitimate patron of the public-house; and I conceive that he may, upon this occasion, be exhibited as presenting his customers with a bag of nails, in reference to the old adage, ‘*Every glass of spirit is a nail in your coffin.*’ ”

“ Ha, ha, ha, — whimsical enough,” cried the vicar; “ and much do I regret to say, that your explanation is not the true one, for it would, no doubt, carry a striking moral with it. The sign,” continued Mr. Twaddleton, “ is not quite so uncommon as you seem to suppose; it was, originally ‘*Pan and his Bacchanals,*’ but by a very natural transition, the figure of the sylvan deity has passed into that of the evil tempter, while the word ‘*Bacchanals,*’ by one of those verbal corruptions, so common in all languages, has been converted into the *bag of nails.* ”

“ Your explanation, vicar, is far more plausible than mine, and although it carries along with it a less useful moral, it has the merit of being more classical.”

The vicar now begged to make an enquiry, which he trusted would not be considered as exceeding those limits of confidence and frankness so indispensable to reciprocal friendship.

“ Fiddlestick — have I not told you, that I am a man of no ceremony; that I despise it, and cannot endure it in my presence? — put your question, and you shall receive the best answer I can give to it.”

“ To speak honestly, then, major, your admiration of antiquities, and the evident extent of your classical acquirements, are circumstances which have excited in my mind the utmost degree of astonishment. Heaven forbid that I should cast the slightest imputation upon the respectability of the military character, but you will readily allow, that the martial spirit is adverse to the gentle arts of peace, and that the young hero usually lays down his books as soon as he takes up his sword; the bustle of a camp is necessarily incompatible with that tranquillity of mind, which is so essential to the study of the classics, and the lamp of the barrack-room is more frequently trimmed in honour of Bacchus than of Minerva; my wonder, therefore, is, to find a son of Mars

as learned as though he were the chosen favourite of Apollo."

"You shall hear my history," answered the major; "which may, perhaps, reconcile the existence of those qualities which appear to you to be so incompatible and inconsistent with each other; in some respects my history is a melancholy one, but I feel that the pain which must attend its recital will be alleviated by the sympathy of your congenial spirit. I received my early education at Winchester school, whence I went off to Cambridge, and was so fortunate as to become sixth wrangler and medallist."

"Bless me!" exclaimed the vicar, "you were of Trinity. Well do I remember the name of Snapwell, as the senior medallist of the year: you were, I think, about two years my elder in the university."

"I was certainly of Trinity," continued the major, "and, but for the circumstance I am about to relate, I should, probably, at this moment, have been a Fellow of that college. My father having died very shortly after my admission, I became dependent upon a rich uncle, whom I had scarcely seen, and who was not

even on speaking terms with the family. On the decease of my father I received a formal letter of condolence, with a qualified assurance of assistance, provided my conduct should justify his patronage: he concluded by a long lecture on the vices of youth, and the terrible extravagancies into which they were so liable to be betrayed. I confess, that from the style and spirit of this letter I did not augur favourably, but I was happily mistaken. My extreme frugality won his heart; he found that his means were not squandered on a barren soil; and, on obtaining the gold medal, pride rivetted the link by which consanguinity had hitherto alone united us. His character now assumed a new aspect; his heart and his purse-strings simultaneously opened; and the same letter which conveyed a pressing invitation to me to spend the vacations at his seat in Yorkshire, enclosed an unlimited order upon his banker: but, to cut my story short, our connection soon ripened into attachment, our attachment into affection, and at his death I found myself in possession of his whole fortune. In a codicil of his will, executed only a few hours before his demise, he expressed a wish that I should decline a college

life, and travel over Europe, but the political state of the Continent at that time opposed an insuperable bar to such a plan, unless I entered the army, and followed its fortunes; of this resource I immediately determined to avail myself, and I may on some future occasion give you an account of my military adventures; at present suffice it to say, that I soon became ardently attached to my profession, and have seen as much active service as most persons of my age. I now come to a melancholy part of my history. I had a sister, who contracted in early life an unfortunate marriage, and at her death left a son totally unprovided for. I determined to make this boy my heir, and to do for my nephew exactly what my uncle had so generously done for me. I know your thoughts, Mr. Twaddleton; you are surprised that I should never have married? My answer will be short, and I trust satisfactory; I met with an early disappointment; enquire no farther. Well, sir, to proceed with my narrative: — My nephew arrived at manhood; he became an accomplished scholar, and a polished gentleman; if his acquirements attracted the admiration, his virtues rivetted the affections of all who knew him; he was, indeed,

to me all that the fondest parent could have desired. I loved him; Heaven knows how dearly! but, weak and wretched mortal that I was, how did I evince my gratitude for such a blessing! I drove him from my presence, and — oh, God! my heart-strings burst as I relate the awful event — he — he perished by shipwreck.”

Bitter was the pang that shot across the pallid countenance of the unfortunate major, as he uttered these last words; and he remained for several minutes as if bereft of all perception: the vicar was also affected, even to tears. The major at length recovered his composure, and proceeded: — “My nephew became violently attached to a young lady of distinguished beauty and accomplishments, but she had no fortune, and I had higher views for him, and therefore peremptorily refused my consent to their union. My worthy friend and solicitor, Mr. Wilcox of Gray’s Inn, offered himself as a mediator in the affair, and it was ultimately arranged that my nephew, Harry Beacham, should travel for two or three years; and that if his attachment remained unsubdued by absence, it should receive my sanction after that period.

He departed, and embarking at Marseilles, the crazy vessel in which he had intrusted himself, meeting with one of those treacherous gales so characteristic of the Mediterranean, foundered in the Bay of Genoa — he perished — and with him was wrecked all the happiness of my life. The fatal account soon reached England, for bad news has wings; a raging fever struck the brain of the unhappy object of Harry's affections. I never saw her; but, through the medium of my kind friend Wilcox, I offered her every consolation in my power: but, alas! to no purpose; although I trust that my conduct on that occasion may be received as some atonement to the manes of my nephew. I intended to regard her as the representative of Harry, and to bequeath her all my fortune; but I shortly learned from Wilcox that death had anticipated my purpose, and united her gentle spirit with that of her adored Harry. These events, as you may suppose, preyed upon my mind, and wrecked my body. My nights were disturbed by the most appalling dreams: the raging deep bellowed in my ears, and the screams of dying mariners pierced my very

soul; the pale and shadowy form of my nephew would then appear half rising from the boisterous billows, calling with piteous moans upon the name of his beloved: suddenly the scene would change; 'the sky would kindle with the magic of summer clouds,' and the turbulent ocean subside into the silvery surface of a tranquil sea, the mass of waters would then seem to divide, and I would feel as if hurled by some gigantic hand into an abyss deeper than plumb-line ever fathomed; there would I see the monsters of the deep at their uncouth gambols; and, in a cavern inhabited by hideous animals, hitherto unknown, the blanched skeleton of the shipwrecked mariner would stalk across my path, and with a piercing yell awake me; thus restoring me to realities scarcely less dreadful than the visions I had witnessed. If my nights were disturbed by dreams, my days were distracted by the most painful reveries; so that my medical attendants entertained serious fears for my reason, and they declared that change of scene could alone save me from the impending danger. Wilcox, ever kind and anxious, urged the necessity of my immediately taking measures to carry the plan into effect. I there-

fore made my will, bequeathing to Wilcox a considerable part of my fortune, and appropriating the remainder to the establishment of certain scholarships at Oxford and Cambridge. The management of my affairs was wholly entrusted to Wilcox, and I left England, with my servant Jacob, as my sole attendant. Having travelled through France, I visited part of Germany and Switzerland, passed into Italy, and spent some time at Milan. The change of scene certainly produced the benefit my physicians had anticipated: I slept with greater tranquillity, and I found myself better able to abstract my mind from the contemplation of those images which had so incessantly harassed me; and I doubt not but that time may still farther blunt the sting of mental agony; for there are already periods at which I can even assume the air of gaiety."

The major here ceased. The vein of melancholy which had pervaded this part of the story greatly affected the vicar, and he determined to beguile the sufferer's mind, as far as he was able from brooding over his woe; as a prelude to his humane design, he invoked the

spirit of Horace, and recited several consoling passages from his beautiful ode to Valgius.*

“But you have not yet informed me,” said Mr. Twaddleton, “what brought you to Overton.”

“True. I became wearied of travelling abroad, and with that restlessness so common to persons in my situation, felt a morbid anxiety to return. On my arrival in London, Wilcox was greatly surprised and vexed at the measure I had taken; and at his suggestion I set off for Bath; but hearing of the seclusion and beauties of Overton, I changed my mind on the journey, and arrived at Ivy Cottage, which my servant, whom I sent forward, had previously secured for my reception. How long I shall remain here, is, as yet, a matter of doubt. If I like the country, and could purchase an eligible place, it is not improbable, but that I may become one of your permanent residents.”

The vicar now took his departure, having obtained a promise from his newly acquired friend, that he would shortly return his visit, and examine the collection, upon which Mr. Twaddleton so greatly prided himself.

* Carm. ix. lib. 2.

It is now time that we should return to the party, whom we shall find arranged as usual around the table in the library. Mr. Seymour resumed the subject of "Compound Forces." He told them they had learned that two or more forces might be so compounded as to produce the same effect as a single one, in a direction, and with a velocity, to be determined by certain laws which he had lately endeavoured to explain.

"I have now to inform you," said he, "that a single force may be resolved into any number of forces; and may, in fact, be regarded as compounded of innumerable oblique ones. In order, however, to render this fact more intelligible, I must refer you to *fig. 6*, from which it will appear that the motion of a body, along the line *A D*, will be the same whether it arise from one single force acting in that direction, or from two forces impressed upon it in the directions *A B*, *A C*, or in those of *A E*, *A F*; and, consequently, although the motion may, in reality, be the effect of a single force, yet it may be considered as compounded of two or more in other directions, since the very same motion would arise from such a composition."

Tom acknowledged the truth of this statement; and Mr. Seymour assured him that, when they came to play at ball and marbles, he should be able to give him a practical demonstration of the fact; for, he would show him that whenever a body strikes a surface obliquely, or in an inclined direction, such a *resolution of force* will actually take place: "and now, Tom," said his father, "give me a marble; for I wish to explain the reason why it turns round, or revolves on its axis, as it proceeds forwards."

"I suppose," said Tom, "it depends upon the action which I give to it by my thumb and finger, when I shoot it out of my hand."

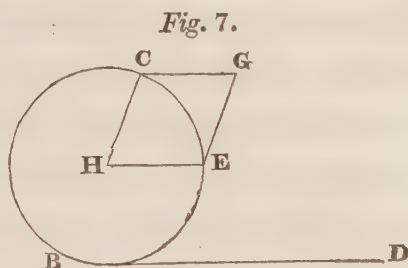
"You are, undoubtedly, capable of thus giving to your marble a certain *spinning* motion, the effect of which we shall have to consider hereafter; but I fancy you would be greatly puzzled to make it proceed without revolving, give it what impulse you might by your hand."

"I have sometimes tried," said Tom, "to make it do so, by pushing it along with a flat ruler, but it always *rolled* in spite of me."

"Then it is clear from your own experiment, that its rotation cannot arise from the cause you would assign to it. If you will

attend to this diagram," continued his father,
 "I will endeavour to explain the operation.

It is evident, that as
 the marble moves
 along the ground
 BD, the motion of
 the point B will be
 retarded by the re-



sistance occasioned by its rubbing on the ground ;
 while the point c, which does not meet with any
 such resistance, is carried forward without oppo-
 sition, and it consequently must move faster than
 the point B ; but, since all the parts of the marble
 cohere, or stick together, the point c cannot
 move faster than B, unless the marble revolves
 from c to E ; and as the several points of the
 marble, which are successively applied to the
 floor, are retarded in their motion, while the
 opposite points move freely, the marble during
 its progressive motion must continue to revolve."

"But you said, papa, that whenever a body
 moved in any direction, except that of a straight
 line, it must have been acted upon by more than
 one force ; and yet the marble not only runs
 along the ground, but turns round at the same
 time, by the simple force of my hand."

“The revolution of the marble, my dear boy, is brought about by no less than three forces: look attentively at the diagram, and you will easily comprehend my explanation. There is, in the first place, the rectilinear motion given to it by your hand; then there is the friction of the ground; since, however, this latter acts in a contrary direction, it merely tends to lessen or counteract the velocity with which the under surface proceeds, and, consequently to give a relatively increased progressive motion to its upper part; then comes that force by which its several parts cohere, and which may be represented by cH ; so that the two forces producing the revolution of the point c , are justly expressed by the lines cG , cH ; but these are in the direction of the two sides of a parallelogram, the point will therefore move along the diagonal cE .”

Mrs. Seymour here interposed, observing that, as it was past one o'clock, the children should be dismissed to their sports in the garden.

“We will instantly proceed to the lawn,” replied Mr. Seymour, “and Tom may try his skill with the *sling*, an amusement which I have provided as a reward for his industry, and which will, at the same time, convey some far-

ther information concerning the nature of those forces we have been just considering. The sling," continued he, "consists, as you perceive, of a leathern thong, broadest in the middle; and tapering off gradually towards both ends. To each extremity is affixed a piece of string. I shall now place a stone in the broad part of the leather, and introduce my middle finger into the loop formed in one of the strings, and hold the other extremity between my fore finger and thumb."

He then whirled it round, and when it had gained sufficient impetus, he let go his hold of the string, and the stone instantly shot forth with amazing velocity.

"See! see! there it goes," exclaimed Tom; "to what a height it ascended!"

"And to what a distance has it been projected!" observed Louisa, who had attentively watched its descent.

"Now, Tom," said his father, "can you explain the operation you have just witnessed?"

"Not exactly, papa."

"Then attend to me: have you not learned that circular motion is always the result of two forces?"

“Undoubtedly,” replied Tom; “of one force which attracts it to the centre around which it moves, and of another which impels it to move off in a right line.”

“Certainly; the former of these forces is therefore termed the *centripetal*, because it draws the body towards the centre, while the latter is called the *centrifugal* force, since its influence disposes the body to fly off from the centre. In circular motion, these two forces constantly balance each other; otherwise it is evident that the revolving body must either approach the centre, or recede from it, according as the one or the other prevailed. When I whirled round the sling, I imparted a projectile force to the stone, but it was prevented from flying off in consequence of the counteracting or *centripetal* force of the string; but the moment I let go my hold of this, the stone flew off in a right line; having been released from confinement to the fixed or central point, it was acted upon by one force only, and motion produced by a single force is, as you well know, always in a right line.”

“But,” observed Louisa, “the stone did not proceed in a straight, but in a curved line :

I watched its direction from the moment it left the sling till it fell to the ground."

"You are perfectly correct," replied Mr. Seymour, "it described a curve, which is called a *parabola*; but that was owing to the influence of a new force which came into play, viz. that of gravity; the effect of which I shall have to explain hereafter."

"I cannot understand," said Tom, "why the stone should not have fallen out of the sling, when you whirled it round over your head."

"Because, my dear, it was acted upon by the *centrifugal* force, which is superior to that of gravity; but I will render this fact more evident by a very simple, and beautiful experiment. I have here a wine-glass, around the rim of which I shall attach a piece of string, so as to enable me to whirl it round. I will now fill it with water, and, although during one part of its revolution, it will be actually inverted, you will find that I shall not spill a single drop of water."

Mr. Seymour then whirled round the glass, and the young party were delighted with the confirmation thus afforded to their father's statement.

“ I see,” said Tom, “ how it happened ; when the glass was inverted, the water could not fall out, because it was influenced by the centrifugal force which opposed gravity.”

“ Exactly. Have you ever observed what happens during the trundling of a mop ? — The threads, which compose it fly off from the centre, but being confined to it at one end, they cannot part from it ; while the water which they contain, being unconfined, is thrown off in right lines.”

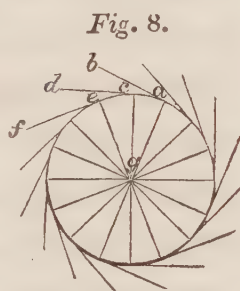
“ I have certainly observed what you state,” said Louisa ; “ the water flies off in all directions from the mop.”

“ Yes,” added Tom, “ the water was not acted upon by the *centripetal* force, as the threads were, and consequently there was nothing to check the *centrifugal* force, which carried the water off in a straight line from the centre.”

“ You are not quite correct,” said Mr. Seymour ; “ the water does not fly off in a right line from the centre, but in a right line in the direction in which it was moving at the instant of its release ; the line which a body will always describe under such circumstances,

is called a *tangent*, because it *touches* the circumference of the circle, and forms a right angle with a line drawn from that point of the circumference to the centre; but I will render this subject more intelligible by a diagram.

Suppose a body, revolving in the circle, was liberated at *a*, it would fly off in the direction *ab*; if at *c*, in that of *cd*; and if at *e*, in that of *ef*; and so on. Now, if you draw



lines from these several points to the centre of the circle, you will perceive that such lines will form, in each case, a right angle. In the experiment which you have just witnessed, the surface of the water must have formed, during its revolution, a right angle with the string, and consequently could not have fallen out of the wine-glass. A knowledge of this law," continued Mr. Seymour, "will explain many appearances which, although familiar, I dare say, have never been understood by you. You may remember accompanying me to the pottery, to see the operation of the turning lathe; it was owing to the centrifugal force, produced by the rotation

of the wheel, that the clay, under a gentle pressure, swelled out so regularly : from a similar cause, the flour is thrown out of the revolving mill as fast as it is ground ; and I shall presently show you, that you are indebted to this same force for the spinning of your top, and the trundling of your hoop ; but let us quit this subject for the present, and pursue the stone in its course, after it is liberated from the sling. Louisa has justly observed, that it described a curve ; can you explain why it should deviate from a straight line ? ”

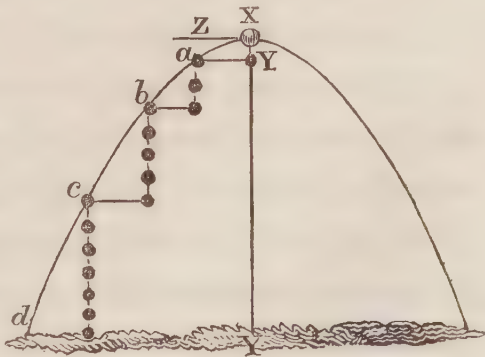
“ Let me see,” said Tom, thoughtfully : “ it would be acted upon by two forces, one carrying it forward in a right line, the other bringing it to the earth ; it would, therefore, not obey either, but describe a diagonal ; but why that diagonal should be a curve I cannot exactly explain.”

“ Then I will give you the reason,” said his father. “ A stone projected into the air is acted upon by no less than three forces ; the force of projection, which is communicated to it by the hand or the sling ; the resistance of the air through which it passes, and which diminishes its velocity without changing its direction ; and

the force of gravity which ultimately brings it to the ground. Now, since the power of gravity, and the resistance of the air, will always be greater than any force of projection we can give a body, the latter must be gradually overcome, and the body brought to the ground; but the stronger the projectile force, the longer will those powers be in subduing it, and the farther will the body go before it falls. A shot fired from a cannon, for instance, will go much farther than a stone thrown from your hand. Had the two forces which acted upon the stone, viz. those of projection and gravity, both produced uniform motion, the body must certainly have descended through the diagonal; but since gravity, as you have already learned, is an accelerating force, the body is made to describe a curve, instead of a straight line. This law, however, will require the aid of a diagram for its explanation.

Fig. 9.

Let x represent the ball at its greatest altitude, xy the force of gravity drawing it downward; and xz that of



projection. We have here, then, two forces acting in the direction of the two sides of a parallelogram. In passing on to z , the ball will perform the diagonal xa ; and, in the next equal space of time, will descend through *three* times the distance, za , and will consequently be found at b ; while in the next period it will fall through *five* equal spaces, and pass to c ; and in the next period, again, as it must fall through *seven* such spaces, it will reach the ground at d , having described a portion of a curve from x to d , or during the time that the two forces were in simultaneous operation. The same principle will explain the curved ascent of the ball, substituting only the laws of retarded for those of accelerated motion; for it is clear that the body, during its *ascent*, will be retarded in the same degree in which it was accelerated during its *descent*."

"Your explanation," said Louisa, "appears very clear and satisfactory."

"The curve which *Projectiles* (that is to say, bodies projected into the air) describe, is termed a *Parabola* (10), although the resistance of the air, which is not recognised in the theory, produces a considerable influence in the practical result."

The children now proceeded to amuse themselves with the sling. Louisa challenged Tom to a trial of skill. She fancied that she could hurl a stone with greater accuracy than her brother; but after several contests she acknowledged herself vanquished, for Tom had succeeded in striking the trunk of an old tree at a considerable distance, while his sister was never able to throw the stone within several yards of the mark.

“Well done, Tom,” exclaimed Mr. Seymour; “why you will soon equal in skill the ancient natives of the Balearic Islands!”

“And were they famous for this art?” asked Louisa.

“With such dexterity,” replied her father, “did they use the sling, that we are told their young children were not allowed any food by their mothers, except that which they could fling down from the beam, where it was placed aloft. I fancy, however, Tom, that you would become very hungry before you could strike an object in yonder poplar.”

“At all events, I will try,” said Tom.

He accordingly whirled round his sling, and discharged its stone, which flew forward with

great velocity, but in a direction very wide from the mark at which it was aimed. In the next moment a violent hallooing was heard: it was from the vicar, who had nearly escaped the boisterous salutation of the falling stone, which, in its anxiety to throw itself at the feet of the reverend gentleman, struck the beaver penthouse, that defended his upper story, and, by a resolution of forces, which we have endeavoured to explain, darted off in the direction of the side of a parallelogram; and was thus averted from the equally sensitive antipodes of his venerable person, the brains in his head, and the corns in his shoes.

“Upon my word, young gentleman!” cried the vicar, “I expected nothing less than the fate of the giant of Gath.”

“My dear Mr. Twaddleton,” exclaimed Tom, in a tone of alarm, “I sincerely hope that you have not been struck.”

“O no; thanks to my clerical helmet, I have escaped the danger which threatened me: but, tell me, what new game is engaging your attention?”

Mr. Seymour said that he had been explaining the scientific principle of the sling; and

that he hoped the vicar was prepared to afford them some information respecting its invention and history.

“The art of slinging, or casting stones,” replied the vicar, “is one of the highest antiquity, and was carried to a great degree of perfection amongst the Asiatic nations. It was well known and practised at a very early period in Europe; and our Saxon ancestors appear to have been very expert in the use of this missile kind of warfare.”

Mr. Twaddleton being desirous of communicating the history of Major Snapwell, begged that Mr. Seymour would allow him a few minutes’ conversation; observing that the attention of the children would be agreeably occupied, during their absence, by their newly acquired amusement.

“We will then, if you please, vicar,” replied Mr. Seymour, “walk to the Geological Temple, where I have lately deposited some specimens which you have not yet seen.”

“To speak sincerely,” said the vicar, “I cannot participate in that high satisfaction which you appear to feel in collecting such hordes of broken rocks and pebbles; where

can lie the utility of such labour? unless, indeed, in pursuance of your Utopian plans, you intend to *Mac-adamise* all the roads of science."

"Is it nothing, my dear Mr. Twaddleton, to discover the structure of different countries?"

"Which the geologist infers," replied the vicar, "from a few *patterns*, picked up at random on the road side! I have good reason for believing that the greater number of rock specimens, which are exhibited by our parlour geologists, as illustrative of the structure of England, have been brought by our ships as ballast from different countries."

"Mr. Twaddleton," said Mr. Seymour, "I will meet you on your own ground: you are an antiquary; if an ancient monument of art be so inestimable, is not a knowledge of the antiquity of the globe itself, at least, of equal interest?"

"I understand you; you would infer that the scriptural account of the deluge is disproved by those Sciolists, whom you dignify by the name of Geologists: I would trust them, as I would a knowing jockey, who pretends to discover the age of a horse by looking into its jaws."

"You speak too flippantly of a class of phi-

losophers who have united their efforts to investigate a sublime subject, upon the true principles of science ; were you to attend the meetings of the Geological Society, and hear the discussions of its members, you would cease to talk thus irreverently.”

“ Although I may be unknown to your genii of the mountains, I am, at all events, acquainted with a kindred class of philosophers who rival them in industry, if not in talents ; and notwithstanding the limited range of their observations, being confined to the mountainous districts they inhabit, I have little doubt but that their labours have proved as acceptable to the world, as those of the disciples of Hutton or Werner. I once visited this district, and although the language of its inhabitants was entirely unknown to me, I soon discovered that they were in serious discourse with each other ; and one of the elders of the fraternity, who was seated on a craggy precipice that overhung an extensive valley, covered with rich verdure, appeared, from his gestures, as if pointing out to his fellow-labourers, who were digging in all directions in search of treasure, the danger of an approaching convulsion.

While I was yet gazing, the fatal catastrophe actually occurred; immense masses of the tottering strata rolled with precipitous haste into the valley, involving in its ruin hundreds of its inhabitants. It was extraordinary to behold the effect of this shock upon those who were beyond the reach of its more destructive influence; hundreds were seen scaling heights that appeared inaccessible; others, stumbling,—falling down frightful precipices,—rising again,—helping or pushing each other on, the foremost serving as so many stepping-stones to those behind, who in their turn hauled up the clusters, over whose backs they had so uncereemoniously vaulted.”

“How awful!” cried Mrs. Seymour; “I never heard of any modern catastrophe of such fearful extent: where did it occur?”

“The vicar, doubtless alludes to the terrible earthquake of Messina, or perhaps to that of Lisbon.”

“I neither allude to the one, nor to the other,” cried Mr. Twaddleton, “and yet, in some respects, the catastrophe which I have described resembled that of Lisbon; for during the dreadful disaster, human beings were seen to take

advantage of the confusion, to murder many of the inhabitants, and to pillage their territories." (11)

"For goodness' sake," cried Mrs. Seymour, "tell us, at once, where this terrible event occurred."

"In a fine Cheshire cheese," exclaimed the vicar, "which had furnished abundant food to the miniature republic of mites that occupied its deep ravines, and alpine heights. I think now," continued the reverend gentleman, "I am amply revenged for the allegorical jokes in which Mr. Seymour has so often indulged at my expense."

"I am well satisfied," said Mr. Seymour; "for by repeating your allegory to my children, I shall be enabled to convey a striking lesson of wisdom. They will learn from it, that there is not any pursuit, however exalted, that may not be assailed by the weapons of ridicule, especially when wielded by those penurious philosophers, whose ideas of utility are circumscribed within the narrow limits of direct and immediate profit."

"It is too true," cried Mrs. Seymour, "that

we are all apt to depreciate those branches of knowledge which do not bear directly upon the comforts or necessities of life ; and the applications of geology are, perhaps, so remote as scarcely to be discovered by the mass of mankind."

" There I must differ with you," replied her husband: " to say nothing of the practical advantages which have accrued to the miner, from this study, it has been the means of bringing hundreds of acres into cultivation, in districts where never a blade of grass had before grown ; (12) and if scholastic researches have thrown additional light on scriptural subjects, they are no more to be compared with those of the geologist on these occasions, than is the light of the glow-worm to that of the sun."

" Hey-day !—what do I hear?" exclaimed the vicar. " Would you compare the testimony of the Apamean medal with that of an unshapen flint ? "

" I would rest my faith upon a *rock*," replied Mr. Seymour ; " the caves of Buckland (13) have done more towards supporting the Mosaic account of the deluge, than all the medals of the

virtuoso. Fossils, in truth, are to the geologist, what medals are to the antiquary, preserving a record of events which must otherwise have perished in the stream of time."

Mr. and Mrs. Seymour and the vicar by this time arrived at the Wernerian Temple, where having discussed several points connected with its objects, Mr. Twaddleton gave an account of Major Snapwell, whose history created considerable interest, and determined Mr. Seymour to call at Ivy Cottage, and invite its inmate to the lodge.



CHAP. VIII.

THE SUBJECT OF ROTATORY MOTION CONTINUED.—

A BALL, BY HAVING A PECULIAR SPINNING MOTION IMPARTED TO IT, MAY BE MADE TO STOP SHORT, OR TO PROCEED IN A RETROGRADE DIRECTION, THOUGH IT MEETS WITH NO APPARENT OBSTACLE.—THE RECTILINEAR PATH OF A SPHERICAL BODY INFLUENCED BY ITS ROTATORY MOTION.—BILBOQUET, OR CUP AND BALL.—THE JOINT FORCES WHICH ENABLE THE BALANCER TO THROW UP AND CATCH HIS BALLS ON THE FULL GALLOP.—THE HOOP.—THE CENTRE OF PERCUSSION.—THE CENTRES OF MAGNITUDE AND GRAVITY.—THE LINE OF DIRECTION.—THE STABILITY OF BODIES, AND UPON WHAT IT DEPENDS.—METHOD OF FINDING THE CENTRE OF GRAVITY OF A BODY.—THE ART OF THE BALANCER EXPLAINED AND EXEMPLIFIED.

“TOM, do you remember that I told you a few days ago,” said Mr. Seymour, “that, by giving a revolving body a peculiar *spinning* motion, certain effects were produced, which I should, on some future occasion, take into consideration?”

“To be sure I do,” replied Tom.

“Well then, attend to me.”

Mr. Seymour took a marble, and, placing it on the ground, gave it an impulse forward by pressing his forefinger upon it: the marble darted forward a few paces, after which it rolled back again.

“That is most extraordinary!” cried Tom; “the marble came back to your hand, as it were, of its own accord, and without having met with any obstacle.”

“And you, no doubt,” said Mr. Seymour, “regard it as contrary to the well known law, that a body once put in motion, in any direction, will continue to move in that direction until some foreign cause oppose it.”

“It really would appear so.”

“It is, however, far otherwise; the force

which I imparted to the marble communicated to it two kinds of motion ; the one projecting it forward, the other producing a rotatory motion round its axis, in a direction opposite to that of its rectilinear course ; and the consequence was simply this, that when the former motion, on account of the friction of the marble on the ground, was destroyed, the rotatory motion continued, and by thus establishing an action in an opposite direction, caused the marble to retrograde. If, however, you will fetch your hoop, I will demonstrate the fact on a larger scale."

Tom accordingly produced the hoop ; and Mr. Seymour projected it forward, giving to it, at the same instant, a spinning motion in an opposite direction. The hoop proceeded forward to a certain distance, when it stopped, and then ran back to the hand.

" Let me beg you," said Mr. Seymour, " to treasure this fact in your memory ; you perceive by it how greatly the progressive direction of a body may be influenced by a rotatory motion around its axis ; and, indeed, the theory of the *rifle* gun (14) is easily deduced from it. It will also explain the effect which a rotatory motion

produces in steadying or disturbing the direction of a projectile. It is for this reason that the balancer constantly whirls round his balls or oranges, as he throws them into the air, with the intention of catching them again."

"But I do not understand," said Tom, "how such a spinning motion can produce the desired effect."

"Have I not frequently warned you against idleness; and do you remember for what reason?"

"You have always said, that an idle boy is sure to get into mischief."

"True; there is an activity in the mind which must be satisfied, and if worthy occupations are not presented to it, it will naturally employ itself by others less salutary. So is it with a ball or orange, it will have a tendency towards rotatory motion, and if left to itself, will assume an untoward axis; to prevent this you give it an axis upon which it may spin with the greatest advantage."

"I do not exactly understand what is meant by an untoward axis," said Tom.

"Suppose a projectile should have a rotatory motion about an axis, which does not coincide

with the direction in which it is moving forward ; is it not clear, that the resistance of the air would cause the body to deviate from the line of its motion ? since the two sides, having different velocities (the rotatory and progressive motions conspiring on one side, while they are in opposition on the other) will be differently affected by such resistance : the resistance, of course, increasing with the velocity. It is upon this principle, that Sir Isaac Newton has explained the irregular motion of the tennis-ball."

" And is that the reason, papa," said Louisa, " that I cannot catch the ball, upon the spike, unless I spin it round before I throw it upwards ?"

" Exactly ; and when we return to the library, I will give you a cup and ball, and you shall play a game at *bilboquet* with me. I think I shall easily convince you, that the rotatory motion of the ball will so steady its course, that the hole will not incline from its original perpendicular direction, and consequently, that it will fall upon the spike which is placed for its reception."

Louisa observed, that she well remembered an allusion to this game in Miss Edgeworth's

Essays on Education; and that, unless she was much deceived, the advantage to be gained by spinning the ball was referred to centrifugal motion, and its effect in preserving the '*parallelism of motion*.'

"I do not recollect that passage," replied the father; "but I will venture to say, that centrifugal force has nothing whatever to do with it; it entirely depends upon giving to the ball an appropriate axis of motion."

"I well remember," observed Tom, "that the rider at Astley's whirled round the oranges as he threw them into the air."

"And I hope that you are now acquainted with the principle which rendered such a rotatory motion necessary: but can you tell me how it could have happened, that the oranges, which were thrown perpendicularly upwards, while the horseman was on the full gallop, should have fallen again into his hand?"

"Ay," said Louisa, "that puzzled me exceedingly; I should have thought he would have ridden away from them, and that they would, accordingly have fallen several feet behind him."

“What say you, Tom, to that?” enquired Mr. Seymour.

“I suppose,” replied Tom, “that the rider calculated upon the distance he would pass forward, before they could fall, and projected them accordingly.”

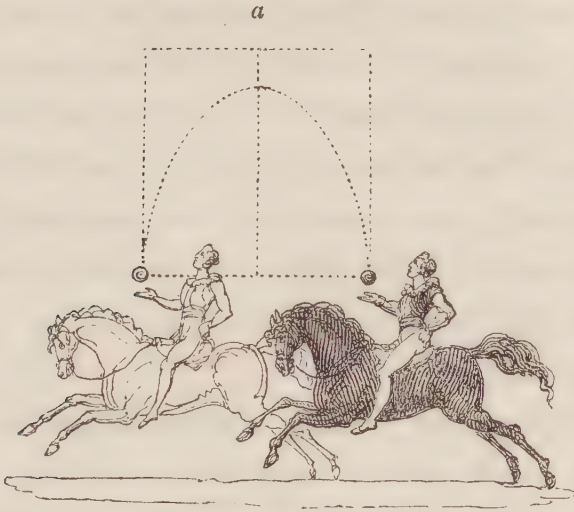
“No, indeed; there is no calculation in the case, nor is any art used to throw the oranges in advance: they are projected perpendicularly from the hand; and if you will only recall to your mind the subject of the ‘Composition of Forces,’ the mystery will vanish.”

“I see it all clearly,” cried Tom; “the orange partakes of the progressive motion of the rider; when, therefore, he throws it upwards, it is influenced by two forces which are in the direction of the two sides of a parallelogram, and it consequently describes the diagonal.”

“You are quite right; but you doubtless will perceive that, instead of a straight line, the orange will describe a parabolic curve.”

“For the same reason, I suppose,” said Tom, “that the stone from the sling described a curve?”

“ Certainly; but see, I have a diagram which will explain the subject more clearly.



The orange, as it is thrown into the air, is influenced by two forces; the one arising from the progressive motion of the rider, the other from the projectile force imparted to it. These two forces are in the direction of the adjacent sides of a parallelogram, and were it not for the operation of gravity, the body would accordingly describe its diagonal in the same space of time as it would have described one of the sides.* The influence of gravity, however, not only deflects it from a right line into a curve, but diminishes its force, so that instead of arriving

* See page 179.

at the opposite angle of the parallelogram *a*, its greatest altitude will be short of that point; it will then descend through a similar curve; and, since the times of ascent and descent are equal*, it will reach the hand of the rider at the very moment he is prepared to receive it; for the orange will have traversed the parabolic curve in the same space of time as the horseman required for passing from one extremity of the curve to the other."

Mr. Seymour having concluded this explanation, much to the satisfaction of the young party, observed that the present occasion was an appropriate one for the introduction of some remarks on the favourite pastime of the Hoop.

"It is a classical pastime," exclaimed the vicar, "and was as common with the Greeks and Romans as it is with boys of the present generation."

"And it has the advantage," added Mr. Seymour, "of sending the tide of life in healthful currents through the veins."

Tom began to trundle his hoop along the gravel walk.

* See page 108.

“ Stop, stop, my dear boy,” cried his father, “ you seem to have forgotten our compact, that every toy should be fairly won, before it was played with. Come upon the lawn, and let me ask you some questions relative to the motions of the hoop. Can you make it stand still upon its edge ? ”

“ Not readily,” was Tom’s reply.

“ And yet,” continued Mr. Seymour, “ during its progressive motion, it rolls on its edge without any disposition to fall : how happens that ? ”

“ It is owing to the centrifugal force, which gives it a motion in the direction of a *tangent* to the circle, and, consequently, overcomes the force of gravity.”

“ Your answer is pat,” replied his father ; “ as long as you give your hoop a certain degree of velocity, the *tangential*, or centrifugal force, overcomes gravity, in the manner you have already witnessed* ; but, when that is slackened, the hoop will fall on its side ; not, however, until it has made several complete revolutions. Now, answer me another question.

* See page 207.

Why is it so difficult to make the hoop proceed straight forward, without turning to the right or left?"

"I suppose it arises from the same cause as that which altered the direction of my marble as it ran along, the inequality of the ground."

"That," replied his father, "would undoubtedly have its influence; but it is principally to be referred to the impossibility of your giving a constantly straight blow by the stick. When it is moving forward, a slight inclination towards either side will cause the parts to acquire a motion towards that side, those which are uppermost being most affected by it; and this lateral, or sideway motion, assisted sometimes by the irregular curvature of the hoop, causes its path to deviate from a rectilinear direction; so that, instead of moving straight forward, it turns to that side towards which it began to incline; and, in this position, its tendency to fall is still farther counteracted by the centrifugal force. I have yet one other question, and, as its answer will lead us into the consideration of a mechanical subject of some importance, I must beg you to bestow all your attention. In

trundling your hoop, have you not often observed that, although the blow inflicted upon it by your stick might have been violent, yet, the effect produced by it was small, in consequence of the hoop having been struck by a disadvantageous part of the stick ? ”

“ Certainly ; I have frequently observed that, if the hoop is struck by the stick either too near the hand or the end, much of its force is lost.”

“ There appears, then, to be some one particular part of the stick which is capable of producing greater effect than can be produced by the same momentum, if imparted at a different point of contact.”

“ It would really seem so.”

“ That is the fact. Every body has what is termed its *centre of percussion*, in which all the percutient force of a body is, as it were, collected ; thus, a stick of a cylindrical figure, supposing the centre of motion at the hand, will strike the greatest blow at a point about two-thirds of its length from the wrist. Now, away with you, and trundle your hoop ; but, remember, that I shall expect you in the library in the course of an hour.”

When the children had reassembled, according to their father's appointment, he informed them that the subject of their present conversation should be the *Centre of Gravity of Bodies*, for the illustration of which he had several interesting toys in readiness.

"Can you tell me, Tom," said he, "what is meant by the centre of gravity of a body?"

"Its central point," answered the boy.

"Certainly not; the central point is termed its centre of *magnitude*, not that of gravity; and it is only when a body is of uniform density, and regular figure, that these centres of magnitude and gravity coincide, or fall in the same spot."

"I now remember," cried Tom, "that the centre of gravity is that point, about which all the parts of a body exactly balance each other."

"Now you are right; it is, in other words, that point in which the whole weight, or gravitating influence, of a body is, as it were, condensed or concentrated, and upon which, if the body be freely suspended, it will rest with security; and consequently, as long as this centre is supported, the body can never fall; while, in every other position, it will endeavour to de-

scend to the lowest place at which it can arrive."

"Have all bodies, whatever may be their shape, a centre of gravity?" asked Louisa.

"Undoubtedly."

"And you say," continued Louisa, "that every body will fall, if this point is not supported."

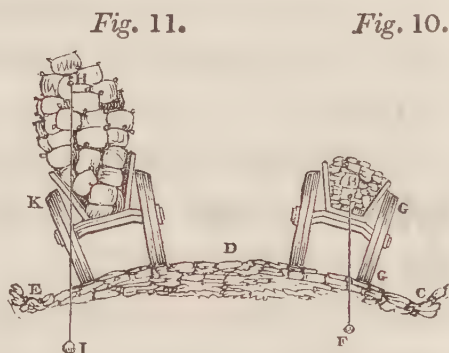
"Infallibly. And now, Tom," said Mr. Seymour, "can you tell me what is meant by the *line of direction*?"

The young philosopher was unable to answer this question, and his father, therefore, informed him that, if a perpendicular line were drawn from the centre of gravity of a body to the centre of the earth, such a line would be termed the *line of direction*; along which every body, not supported, endeavours to fall; and he was also informed that, if this said line fell within the base of a body, such a body was sure to stand; but never otherwise.

Louisa observed that she was not quite sure she understood her papa's meaning, and therefore begged for further explanation.

“ I will exemplify it,” replied Mr. Seymour, “ by a drawing. *Fig. 10.* represents a load of stones in a cart moving upon the sloping road *c d e*; this load, being low down in the cart, *B* will represent its centre of gravity, and *B F* its line of direction, which,

you perceive, falls much within the supporting or lower wheel *G*; and there cannot, therefore, be any danger of such a



cart being overturned; but in *fig. 11.* the centre of gravity is raised from its former position to *H*, and *H I* is now the line of direction; which, falling without the base, or wheel *K*, the load will not be supported, and must consequently fall. These figures,” added Mr. Seymour, “ will also explain a fact which you must have frequently observed, that a body is stable or firm in proportion to the breadth of its base; hence the difficulty of sustaining a tall body, like a walking-stick, upon its narrow base; or that of balancing a hoop upon its edge, or a top

upon its point; while, on the contrary, it is almost impossible to upset the cone or the pyramid, since, in the latter cases, the *line of direction*, falls within the middle of the base, the centre of gravity of the body being necessarily low."

"I suppose," observed Louisa, "that this is the reason why carriages, when too much loaded, are so apt to upset."

"Say, when too much loaded on their *tops*, and you will be right. As you now, I trust, understand this part of the subject, let us proceed a step farther; if you take any body, with a view to suspend it, is it not evident, that if it be suspended by that point in which the centre of gravity is situated, it must remain at rest in *any* position indifferently?"

"I thought," said Tom, "we had already settled that question."

"True, my dear boy; but there is another question of great importance arising out of it, and which you have not yet considered: tell me, should the body be suspended on any other point, in what position it can rest."

"I do not exactly understand the question."

“ There are,” replied his father, “ only two positions in which it could rest, either where the centre of gravity is exactly *above*, or exactly *below*, the point of suspension ; so that, in short, this point shall be in the *line of direction*. Where the point of suspension is *below* the centre of gravity it is extremely difficult to balance or support a tall body by such a method, because the centre of gravity is always endeavouring to get under the point of support. Look at this diagram, and you will readily comprehend my meaning. κ is the centre of gravity of the diamond-shaped figure, which may be supported, or balanced, on a pin passing through it at M , as long as the centre of gravity κ is immediately over the point of suspension M : but if that centre is removed in the slightest degree, either to the right or left of its place κ , the body will no longer retain its erect position $I \kappa L$, but it will revolve upon M , and place itself in the situation indicated by the dotted lines beneath the point M ; and its centre of gravity will now be removed to N , directly

Fig. 12.



under M , and in the line κL , which, as you well know, is the line of direction. Have I rendered myself intelligible?"

"I understand it perfectly," answered Tom.

"And do you also, my dear Louisa?"

Louisa's answer was equally satisfactory, and Mr. Seymour went on to state that the information they had now acquired, would enable them to ascertain the situation of the centre of gravity of any plane surface which was portable, notwithstanding it might possess the utmost irregularity of shape.

"You shall, for example," continued he, "find the centre of gravity in your kite."

"I cannot say," observed Tom, "how I should set about it."

"Well, fetch your kite, and I will explain the method."

Tom soon produced it, and the tail having been removed, Mr. Seymour proceeded as follows:—

"I now," said he, "suspend the kite by the loop at its bow, and since it is at rest, we know that the centre of gravity must be exactly below the point of suspension; if, therefore, we

draw a perpendicular line from that point, which may be easily done by a plumb-line, with a weight attached to it, such a line will represent the *line of direction*, as indicated by $A B$ in *fig. 13.*"

"It is clear enough," said Tom, "that the centre of gravity must lie in the line $A B$, but how are we to find in what part of it?"

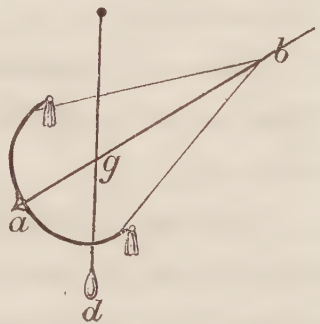
Fig. 13.



"By suspending the kite in another direction," answered Mr. Seymour, who then hung it up in the position represented at *fig. 14.*, "and then by drawing another perpendicular from the new point of suspension."

"The centre of gravity," said Louisa, "will in that case be in the line $c d$, as it was before in that of $a b$."

Fig. 14.



"In both the lines!" exclaimed Tom, with some surprise; "it cannot be in two places."

"And therefore," added Mr. Seymour, "it must be in that point, in which the lines meet"

and cross each other : so saying, he marked the spot *g* with his pencil, and then told his little scholars, that he would soon convince them of the accuracy of the principle. He accordingly placed the head of his stick upon the pencil mark, and the kite was found to balance itself with great exactness."

" True, papa," said Tom, " that point must be the centre of gravity, for all the parts of the kite exactly balance each other about it."

" It is really," observed Louisa, " a very simple method of finding the centre of gravity."

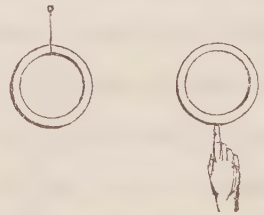
" It is," said Mr. Seymour ; " but you must remember that it will only apply to a certain description of bodies : when they are not portable, and will not admit of this kind of examination, their centres of gravity can only be ascertained by experiment or calculation, in which the weight, density, and situation of the respective materials must be taken into the account. Having proceeded thus far, you have next to learn that the centre of gravity is sometimes so situated as not to be *within* the body, but actually at some distance from it."

" Why, papa !" exclaimed Tom, " how can that possibly happen ? "

“ You shall hear. The centre of gravity, as you have just said, is that point about which all the parts of a body balance each other: but it may so happen that there is a vacant space at this point. Where, for example, is the centre of gravity of this ring? Must it not be in the space which the ring encircles?”

“ I think it must,” said Tom; “ and yet, how can it be ever supported without touching the ring?”

“ That point cannot be supported,” answered his father, “ unless the ring be so held that the line of direction shall fall within the base of the support, which will be the case whether you poise the ring on the tip of your finger, or suspend it by a string, as represented in the figures which I have copied from the ‘ Conversations on Natural Philosophy.’ I need scarcely add, that it will be more stably supported in the former position, because the centre of gravity is below the point of suspension; whereas, in the latter, the base is extremely narrow, and it will, consequently, require all the address of the balancer to pre-



vent the centre of gravity from falling beyond it. As you are now in possession of all the leading principles upon which the operations of the centre of gravity depend, I shall put a few practical questions to you, in order that I may be satisfied you understand them. Tell me, therefore, why a person who is fearful of falling, as, for instance, when he leans forward, should invariably put forward one of his feet, as you did the other day, when you looked into Overton well?"

"To increase his base," answered Tom; "whenever I lean greatly forward, I should throw the line of direction beyond it, did I not at the same instant put out one of my feet, so as to extend my base, and thus to cause the line to continue within it."

"Rightly answered; and, for the same reason, a porter with a load on his back leans forward, to prevent his burthen from throwing the line of direction out of the base behind. Did you ever observe the manner in which a woman carries a pail of water?"

"To be sure," said Tom; "she always stretches out one of her arms."

"The weight of the pail," continued Mr.

Seymour, "throws the centre of gravity on one side, and the woman, therefore, stretches out the opposite arm, in order to bring it back again into its original situation; but a pail hanging on each arm is carried without difficulty, because they balance each other, and the centre of gravity remains supported by the feet."

"I see," said Louisa, "that all you have said about the woman and her pail must be true; but how could she have learned the principle which thus enabled her to keep the centre of gravity in its proper place?"

"By experience. It is very unlikely that she should ever have heard of such a principle, any more than those people who pack carts and waggon, and yet make up their loads with such accuracy as always to keep the line of direction in, or near, the middle of the base. But to proceed to another example — have I not frequently cautioned you against jumping up suddenly in a boat? Can you tell me upon what principle such an operation must be attended with danger?"

"I suppose," said Tom, "for the very same reason that a waggon is more likely to be overturned when its top is too heavily laden; it would elevate the centre of gravity, and thereby

render the line of direction liable to be thrown beyond the base, and so upset the boat.”

Mr. Seymour observed, that after this lesson he thought the balancing which Tom and Louisa had witnessed at Astley’s theatre, last year, would cease to appear so miraculous. Louisa declared that she had now discovered the whole mystery.

“ You have doubtless perceived,” said her father, “ that the art entirely consists in dexterously altering the centre of gravity upon every new position of the body, so as constantly to preserve the line of direction within the base. The rope-dancer effects this by means of a long pole, the ends of which are loaded by weights, and which they hold across the rope. If you had paid sufficient attention to their movements, you must have perceived how steadily they fixed their eyes on some object near the rope, so as to discover the slightest deviation of their centre of gravity to one or the other of its sides, which they no sooner detect, than they instantly rectify it by a countervailing motion of their pole, and are thus enabled to preserve the line of direction within the narrow base. This very same expedient is frequently practised by ourselves ; if we

slip or stumble with one foot, we naturally extend the opposite arm, making the same use of it as the rope-dancer does of his pole. Many birds, also, by means of their flexible necks, vary the position of their centre of gravity in the same manner. When they sleep, they turn it towards the back, and place it under the wing, in order to lay the greatest weight on the point above the feet."

"What an interesting subject this is," cried Louisa, "and how many curious things it is capable of explaining!"

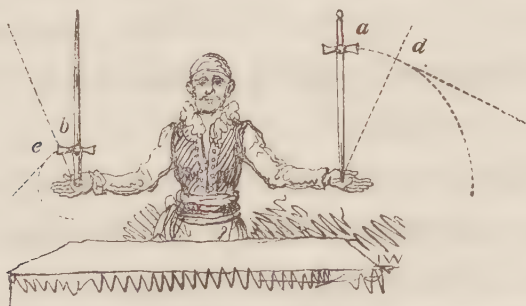
"Indeed is it; and I shall take an opportunity of pointing out several specimens of art(15) which are indebted for their stability to the scientific application of the principle we have been considering; — but I have now a paradox for you, Tom.

"Let us hear it, papa."

"How comes it that a stick, loaded with a weight at the upper extremity, can be kept in equilibrio, on the point of the finger, with much greater ease than when the weight is near the lower extremity; or, for instance, that a sword can be balanced on the finger much better, when the hilt is uppermost?"

“That is indeed strange. I should have thought,” replied Louisa, “that the higher the weight was placed above the point of support, the more readily would the line of direction been thrown beyond the base.”

“In that respect you are perfectly right; but the balancer will be able to restore it more easily in one case than in the other; since, for reasons which you will presently discover, the greater the circle which a body describes in falling, the less will be its tendency to fall. Look at the sketch which I have prepared for the explanation of this fact, and I think you will readily comprehend the reason of it.



“When the weight is at a considerable distance from the point of support, its centre of gravity, in deviating either on one side or the other from a perpendicular direction, describes a larger

circle, as at *a*, than when the weight is very near to the centre of rotation or the point of support, as at *b*. But, in a large circle, an arc of any determinate extent, such as an inch, for example, describes a curve which deviates much less from the perpendicular than if the circle were less; as may be seen by comparing the positions of the sword at *d* and *e*: and the sword at *d* will not have so great a tendency to deviate farther from the perpendicular, as that at *e*; for its tendency to deviate altogether from the perpendicular is greater, according as the tangent to that point of the arc, where it happens to be, approaches more to the vertical position. You see then that it is less difficult to balance a tall, than a shorter pole; and it is, for the same reason, that a person can walk with greater security on high, than on low stilts."

"That is very clear," said Louisa, "although, before your explanation, I always associated the idea of difficulty with their height."

"I suppose," added Tom, "that the whole art of walking on stilts may be explained by the principles you have taught us."

"Undoubtedly it may; for the equilibrium is preserved by varying the position of the body,

and thus keeping the centre of gravity within the base."

"It must be a great exertion," observed Louisa.

"Before custom has rendered it familiar; after which, there is no more fatigue in walking on stilts, than in walking on our feet. There is a district in the south of France, called the Desert of Landes, which runs along the sea coast between the mouths of the Adour and Gironde, where all the shepherds are mounted on stilts; on which they move with perfect freedom, and astonishing rapidity; and so easily does habit enable them to preserve their balance, that they run, jump, stoop, and even dance, with ease and security."

"How very odd," said Tom; "what can be their motive for such a strange habit?"

"Its objects," replied his father, "are important: to keep the feet out of the water, which, during the winter, is deep on the sands; and to defend them from the heated sand during the summer; in addition to which, the sphere of vision over so perfect a flat is materially increased by the elevation, and the shepherds are

thus enabled to see their flocks at a much greater distance. They cannot, however, stand perfectly still upon their stilts, without the aid of a long staff, which they always carry in their hands ; this guards them against any accidental trip, and when they wish to be at rest, forms a third leg that keeps them steady."

"I suppose," said Louisa, "that the habit of using these stilts is acquired while they are very young."

"It is, my dear: and it appears that the smaller the boy is, the higher are his stilts; a fact which affords a practical proof of the truth of what I have just stated."

"The stork is said, in my work on Natural History, to be always walking on stilts," said Louisa; "and yet it does not appear to fatigue him."

"That is very true," replied the father; "but you must remember, that nature has furnished the bird with a provision, by which the legs are kept extended without any exertion of the muscles, in the manner of certain springs; a structure which enables it to pass whole days and nights on one foot, without the slightest fatigue."

“ But, papa,” said Tom, “ I have yet some more questions to ask you on the subject of balancing. I am not at all satisfied about many of the tricks that we saw last year ; indeed, I cannot believe, that many of those astonishing feats will admit of explanation from the rules you have just given us.”

“ I very well know to what you allude,” replied Mr. Seymour. “ Many singular deceptions are certainly practised by removing the centre of gravity from its natural into an artificial situation, or by disguising its place ; thus, a cylinder placed upon an inclined surface may be made to run *up*, instead of *down* hill. I can even appear to balance a pailful of water on the slender stem of a tobacco-pipe : but I shall be enabled to explain the nature of these deceptions by some toys which I have provided for your amusement, and which I must say you are fully entitled to possess, as a reward for the clear and satisfactory manner in which you have this day answered my questions. But see ! here comes Mr. Twaddleton ; he would really seem to possess an instinct that always brings him to the

lodge whenever I am preparing some amusement for you."

The vicar smiled as he entered the room, but unwilling to interrupt the lesson, he placed his fore finger on his lip, and with a significant nod, silently took a seat at the table. The children laughed aloud at this cautious demeanour; and Tom exclaimed, "Why, Mr. Twaddleton, our lesson is over, and we are going to receive some new toys as a reward."

"I have here," said Mr. Seymour, as he opened a large wooden box, "a collection of figures, which will always raise themselves upright, and preserve the erect position; or regain it, whenever it may have been disturbed."

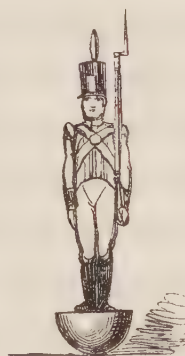
He then arranged these figures in battalion on the table, and striking them flat by drawing a rod over them, they immediately started up again, as soon as it was removed. "These figures," continued he, "were bought at Paris some years ago, under the title of '*Prussians*.'"

"I have seen screens similarly constructed," said Mrs. Seymour, "which always rose up, of themselves, upon the removal of the force that had pressed them down."

“ I will explain their principle,” said Mr. Seymour.

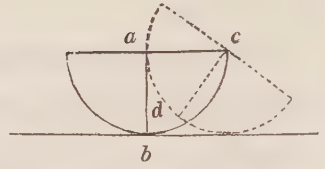
“ Suppose we first examine the construction of the figure,” observed the vicar. “ Bless me ! why it is like Philotus the poet, who was so thin and light, that lead was fastened to his shoes to prevent his being blown away.”

“ The figure,” said Mr. Seymour, “ is made of the pith of the elder tree, which is extremely light, and is affixed to the half of a leaden bullet ; on account, therefore, of the disproportion between the weight of the figure and that of its base, we may exclude the consideration of the former, and confine our attention to the latter. The centre of gravity of the hemispherical base is, of course, in its axis ; and therefore tends to approach the horizontal plane as much as possible, and this can never be accomplished, until the axis becomes perpendicular to the horizon. Whenever the curved surface is in any other position, the centre of gravity is not in the lowest place to which it can descend, as may be seen by the diagram which I have



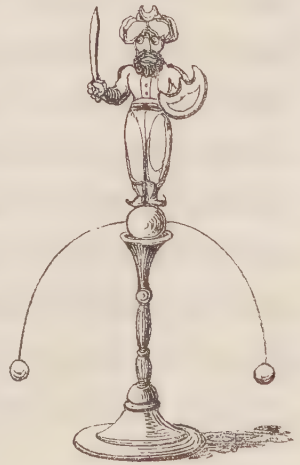
just sketched. If the axis $a b$ be removed to $c d$, it is evident that the centre of gravity will be raised, and that, if left alone, it would immediately descend again into its original position."

Fig. 14.



"I understand it perfectly," said Tom. "When the axis $a b$ is perpendicular, the centre of gravity will be in its lowest point, or as near the earth as it can place itself; when, therefore, the figure is pressed down, the centre of gravity is raised, and, consequently, on the removal of that pressure, it will descend to its original position, and thus raise the figure."

"I see you understand it. Here, then," continued Mr. Seymour, "is another toy in further illustration of our subject. It consists of a small figure, supported on a stand by a ball, which is quite loose; and yet it is made to turn and balance itself in all directions, always recovering its erect position, when the force applied to it is removed. The two weights, in this case,



bring the centre of gravity considerably *below* the point of suspension or support, and therefore maintain the figure upright, and make it resume its perpendicular position, after it has been inclined to either side; for the centre of gravity cannot place itself as low as possible, without making the figure stand erect."

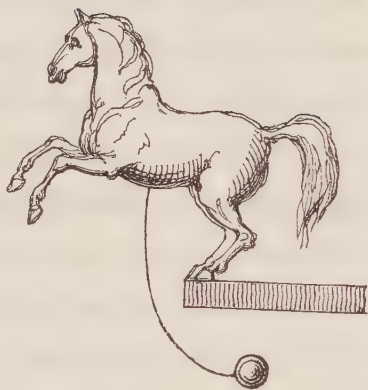
"That is very evident," cried Louisa.

"I shall next exhibit to you," continued Mr. Seymour, "a toy that furnishes a very good solution of a popular paradox in mechanics; viz. *A body having a tendency to fall by its own weight, how to prevent it from falling, by adding to it a weight on the same side on which it tends to fall.*"

"That is indeed a paradox!" exclaimed Louisa. "The next time I see the gardener sinking under the load of a heavy sack, I shall desire him to lighten his burden by doubling its weight."

"Will you, indeed, Miss pert? I do not think so, after you have seen the operation of the toy I am now about to exhibit. Here, you perceive, is a horse, the centre of gravity of which would be somewhere about the middle of its body; it is, therefore, very evident that, if I

were to place its hinder legs on the edge of the table, the line of *direction* would fall considerably beyond the base, and the horse must be precipitated to the ground; you will, however, perceive that there is a stiff wire at-



tached to a weight which is connected with the body of the horse, and by means of such an addition, the horse prances with perfect security at the edge of the precipice; so that the figure which was incapable of supporting itself is actually prevented from falling, by adding a weight to its unsupported end!"

The children admitted the truth of this statement, and were not immediately prepared to explain it.

"The weight, indeed, appears to be added on that side; but, in reality, it is on the opposite side," said the vicar.

"In order to produce the desired effect," observed Mr. Seymour, "the wire must be bent, so as to throw the weight far back, under

the table; by which contrivance, since the centre of gravity of the whole compound figure is thrown into the leaden weight, the hind legs of the horse thus become the point of suspension, on which the ball may be made to vibrate with perfect security."

"Now I understand it," cried Tom; "instead of the weight supporting the horse, the horse supports the weight."

"Exactly so. You perceive, therefore, from these few examples, that the balancer, by availing himself of such deceptions, and combining with them a considerable degree of manual dexterity, may perform feats, which, at first sight, will appear in direct opposition to the laws of gravity. There is also another expedient, of which the balancer avails himself, to increase the wonder of his performances, and that is the influence of rotatory motion, which, you have already seen, may be made to counteract the force of gravity."

"I remember that the most surprising of all the tricks I witnessed was one, in which a sword was suspended on a key, which turned round on the end of a tobacco pipe; on the top of the sword a pewter plate was, at the same time, made to revolve with great velocity."

“ I well remember the trick to which you allude. The rotatory motion prevented the sword from falling, just, as you will hereafter find, the spinning of the top will preserve it in an erect position. There is also another effect produced by rotatory motion, with which it is essential that you should become acquainted. You, no doubt, remember that momentum, or the velocity of a body, will compensate for its want of matter. A number of bodies, therefore, although incapable of balancing each other, when in a state of rest, may be made to do so, by imparting to them different degrees of motion. I believe that you are now acquainted with all the principles, upon which the art of balancing depends; and I have little doubt, should we again witness a performance of this kind, that you will be able to explain the tricks, which formerly appeared to you so miraculous.”





CHAP. IX.

MISS KITTY RYLAND'S DEPARTURE FOR LONDON. —
THE INTRODUCTION OF A NEW CHARACTER. —
THE WHIP AND PEG TOP. — HISTORICAL NOTICES
RELATIVE TO THE TOP. — THE POWER BY WHICH
IT IS ENABLED TO SUSTAIN ITS VERTICAL PO-
SITION DURING THE ACT OF SPINNING. — THE
SLEEPING OF THE TOP EXPLAINED. — WHAT
ENABLES IT TO RISE FROM AN OBLIQUE INTO
A VERTICAL POSITION. — THE CAUSES OF ITS
GYRATION. — THE SEE-SAW. — AN ANTIQUARIAN
HISTORY OF THE BALL.

“MY dear,” said Mr. Seymour, addressing his wife, as he entered the library with the vicar, “we have just returned from a visit to Major Snapwell; he is, indeed, a scholar, and a man of the world, and his misfortunes give him an additional claim upon our friendship and hospitality. He appears delighted with the rural charms of Overton, and intends to

remain for several weeks, at least, amongst us; I have, therefore, requested him to favour us with his company at dinner to-morrow, and our worthy friend here has promised to join our party; and," added he, "I will make one other attempt to engage the company of Mr. Richdale."

The vicar now related to Mrs. Seymour the account of Miss Kitty Ryland's visit to the major, with the particulars of which the reader has been already made acquainted.

"By the by," said the vicar, "I have a piece of news to tell you about Miss Kitty, that, I think, will astonish you. She left Overton this morning in the mail for London."

"Miss Kitty gone to London!" exclaimed Mrs. Seymour; "well, that is indeed extraordinary news."

"Yes," replied the vicar; and Annette tells me, that the journey was hastily decided upon, in consequence of some advertisement that appeared in the Times of yesterday."

"An advertisement for a wife. I will venture a wager that I have guessed it."

"I actually believe you are right," said the vicar, "for, on seeing the village newspaper, I observed so many marks opposite to an adver-

tisement, which I will read to you, that I have little doubt but Miss Kitty's thumbs have been fidgeting in that quarter."

Mr. Twaddleton here produced the paper from his pocket, and read the following advertisement: —

"To any Maiden Lady with an independent income, who may be desirous of improving her situation. — X. Z. presumes to offer his services to any lady who may come under the above description; and he begs to assure her, that reciprocal benefits will seal the contract, to which the advertiser thus delicately seeks to solicit attention. A personal interview is the only form of communication which it would be expedient to adopt. A letter addressed to X. Z., at the Gray's Inn Coffee-house, appointing the time and place of meeting, will be punctually attended to. N.B. The strictest confidence and secrecy must be mutually guaranteed."

"I have no longer the least doubt upon the subject," cried Mr. Seymour; "but let the advertising swain be whom he may, by heavens, he is likely to catch a Tartar."

The vicar enquired whether they should not join the children, whom he perceived were engaged in their sports on the lawn.

“ In a few minutes ; I am only awaiting the arrival of Robert from the post,” said Mr. Seymour ; “ but see, here he comes with my letters. I perceive there is one from Cheltenham, addressed to Mrs. Seymour.”

“ For me !” exclaimed the lady. “ Who can have written to me from Cheltenham ?”

The seal was broken, and the correspondent appeared to be a Miss Villers, for whom the family of Overton entertained the highest regard.

“ I am quite delighted,” said Mrs. Seymour, “ to have heard again from her ; for although our acquaintance has been interrupted, her interesting manners have made a lasting impression upon me. It is nearly two years since the receipt of her last letter, but I perceive that she has had a very long illness.”

“ And is she now at Cheltenham ?” asked Mr. Seymour.

“ She is ; and she offers to pay us a visit in about a fortnight, should it be convenient to us to receive her.”

“ I shall be happy, as you well know,” said her husband, “ to receive Miss Villers at all times ; her society must be of the greatest advantage to Louisa. I beg that you will not lose any time in answering her letter, and in com-

municating the pleasure we all anticipate from her proposed visit."

Mr. Seymour and Mr. Twaddleton now joined the children.

"I rejoice to find you at so classical a pastime," said the vicar, as he approached Tom, who was busily engaged in spinning his top. The top, my boy, is a subject which the great Mantuan bard did not consider beneath the patronage of his muse: but, hey-day! this is not the '*volitans sub verbere turbo*' of the immortal Virgil; the top of antiquity was the whip-top, the peg-top is a barbarous innovation of modern times; a practical proof of the degeneracy of the race. Even boys, forsooth, must now-a-days have their activity cramped by inventions to supersede labour: well may we regard the weapons, which our sturdy ancestors wielded, as instruments rather calculated for giants than men, if such pains be taken to instil into the minds of youth the mischievous spirit of idleness."

"My dear sir," said Tom, who was always grieved at displeasing the vicar, "if it will gratify you, I will spin my *whip*-top, for I have an excellent one which my papa has lately given me."

“ Well said ! my dear boy. ‘ *Puer bonæ spei*’
— What a pity would it be to damp so noble a
spirit ; get your whip-top.”

Tom accordingly placed the Virgilian top
upon the ground, and as the boy plied the
whip, so did the vicar lash the air with his
quotation ; running round the top in apparent
ecstasy, while he repeated the well known lines
from the seventh *Æneid* : —

“ Ille actus habena
Curvatis fertur spatiis ; stupet inscia turba,
Impubesque manus, mirata volubile buxum :
Dant animos plagæ.” *

As Mr. Twaddleton thus gave vent to that
fervour which was ever kindled by collision
with Virgil, Tom gave motion to his top, which
swaggered about with such an air of self-im-
portance, that, to the eye of fancy, it might
have appeared, as if proudly conscious of the
encomiums that had been so liberally lavished
upon it.

“ The Grecian boys, as Suidas informs us,
played also with this top,” continued the vicar.

* “ The wooden engine flies and whirls about,
Admired, with clamours, of the beardless rout :
They lash aloud ; each other they provoke,
And lend their little souls at every stroke.”

DRYDEN.

“ And pray, may I ask,” said Mr. Seymour, “ whether it was not introduced into this country by the Romans ? ”

“ Probably,” replied the vicar. “ Figures representing boys in the act of whipping their tops first appear in the marginal paintings of the manuscripts of the fourteenth century ; at which period, the form of the toy was the same as it is at present, and the manner of impelling it by the whip can admit of but little if any difference. In a manuscript *, at the British Museum, I have read a very curious anecdote which refers to Prince Henry, the eldest son of James the First ; with your permission I will relate it to you.”

Here the vicar extracted a memorandum-book from his pocket, from which he read the following note : —

“ The first tyme that he, the prince, went to the towne of Sterling to meete the king, seeing a little without the gate of the towne a stack of corne, in proportion not unlike to a topp, wherewith he used to play, he said to some that were with him, ‘ Loe there is a goodly topp : ’

* Harl. lib. i. marked 6391.

whereupon one of them saying, ‘ Why doe you not play with it then ? ’ he answered, ‘ Set you it up for me, and I will play with it.’ ”

“ Was not that a clever retort of the young prince ? ” said the vicar, as he returned the manuscript into his memorandum-book ; “ and I think it must have confounded the courtier who could have asked so silly a question.”

“ Well, Tom,” said Mr. Seymour, “ let us see whether you can set up your own top, so that it shall stand steadily on its point.”

“ I have often tried that experiment,” answered Tom, “ but could never succeed in keeping the line of direction within its narrow base.”

“ And yet, when in rotatory motion, its erect position is maintained without difficulty ; how is that ? ”

“ Is it not owing to the centrifugal force ? ” asked Tom.

“ Undoubtedly ; but as the subject is highly interesting, I will endeavour to explain it more fully. You must, however, first obtain permission from the vicar to spin your humming-top, for that will better illustrate the phenomena which it is my wish to examine.”

“ If your object is the exercise of the body, let us spin the whip-top,” replied the vicar; but if you wish to exercise the boy’s mind, I cannot object to your selecting the top best calculated to fulfil that desire.”

Tom having accordingly prepared his top, pulled the string, and set the wooden machine spinning on the floor.

“ Now, Tom, I will explain to you the reason of the top being able to sustain its vertical position. You have already learned, from the action of the sling, that a body cannot move in a circular path, without making an effort to fly off in a right line from the centre *; so that, if a body be affixed to a string, and whirled round by the hand, it will stretch it, and in a greater degree according as the circular motion is more rapid.”

“ Certainly,” said Tom.

“ The top, then, being in motion, all its parts tend to recede from the axis, and with greater force the more rapidly it revolves : hence it follows that these parts are like so many powers

* Page 206.

acting in a direction perpendicular to the axis ; but, as they are all equal, and as they pass all round with rapidity by the rotation, the result must be that the top is in equilibrio on its point of support, or on the extremity of the axis on which it turns. But see, your top is down."

" And what is the reason," asked Tom, " of its motion being stopped ?"

" I can answer that question, papa," said Louisa ; " is it not owing to the friction of the ground ?"

" Certainly ; that has, doubtless, its influence : but the resistance of the air is also a powerful force upon this occasion. A top has been made to spin in vacuo as long as 2h. 16'.* But come, Tom, spin your top once more. Observe," exclaimed Mr. Seymour, " how obliquely the top is spinning. It is now gradually rising out of an oblique position ; — now it is steadily spinning on a vertical axis ; — and now its motion is so steady, that it scarcely seems to move."

" It is *sleeping*, as we call it," said Tom.

" Its centre of gravity is now situated per-

* Short on 'Serson's Horizontal Top.' Phil. Trans. vol. xlvii. p. 352.

pendicularly over its point of rotation: but attend to me," continued Mr. Seymour, "for I am about to attempt the explanation of a phenomenon which has puzzled many older and wiser philosophers than yourselves. It is evident that the top, in rising from an oblique to a vertical position, must have its centre of gravity raised; what can have been the force which effected this change?"

"Was it the centrifugal force?" asked Tom.

"Certainly not," said Mr. Seymour, "as I will presently convince you."

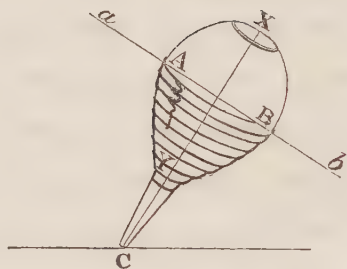
"Then it must have been the resistance of the air," said Louisa.

"No; nor was it the resistance of the air," replied her father: "for the same effect takes place in vacuo."

"Then pray inform us, by what means the top was raised."

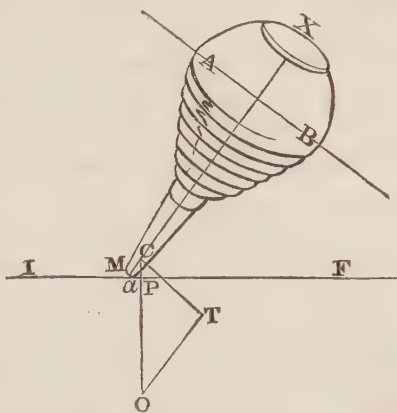
"It entirely depended upon the form of the extremity of the peg, and not upon any simple effect connected with the rotatory or centrifugal force of the top. I will first satisfy you that, were the peg to terminate in a fine point, the top never could raise itself. Let A B C be a top

spinning in an oblique position, having the end of the peg, on which it spins, brought to a fine point. It will continue to spin in the direction in which it



reaches the ground, without the least tendency to rise into a more vertical position; and it is by its rotatory or centrifugal force that it is kept in this original position: for if we conceive the top divided into two equal parts A and B by the line $x\ c$, and suppose that at any moment during its spinning, the connection between these two parts were suddenly dissolved, then would the part A fly off with the given force in the direction a , and the part B with an equal force in the direction b ; whilst, therefore, these two parts remain connected together, during the spinning of the top, these two equal and opposite forces A and B will balance each other, and the top will continue to spin on its original axis. Having now shown that the rotatory or centrifugal force can never make the top rise from an oblique to a vertical position, I shall proceed to explain the true cause of this change,

and I trust you will be satisfied that it depends upon the bluntness of the point. Let ABC be a top spinning in an oblique position, terminating in a very short point with a hemispherical shoulder PaM . It is evident that, in this case, the top will not spin upon a the end of the true



axis $x a$, but upon P , a point in the circle PM , to which the floor IF is a tangent. Instead, therefore, of revolving upon a fixed and stationary point, the top will roll round upon the small circle PM on its blunt point, with very considerable friction, the force of which may be represented by a line OP at right angles to the floor IF , and to the spherical end of the peg of the top: now it is the action of this force, by its pressure on one side of the blunt point of the top, which causes it to rise in a vertical direction. Produce the line OP till it meets the axis c ; from the point c draw the line CT perpendicular to the axis ax , and TO parallel

to it; and then, by a resolution of forces, the line TC will represent that part of the friction which presses at right angles to the axis, so as gradually to raise it in a vertical position; in which operation the circle PM gradually diminishes by the approach of the point P to a , as the axis becomes more perpendicular, and vanishes when the point P coincides with the point a , that is to say, when the top has arrived at its vertical position, where it will continue to *sleep*, without much friction, or any other disturbing force, until its rotatory motion fails, and its side is brought to the earth by the force of gravity."

"I *think* I understand it," said Tom, "although I have some doubt about it; but if you would be so kind as to give me the demonstration in writing, I will diligently study it."

"Most readily," said Mr. Seymour. "Indeed I cannot expect that you should comprehend so difficult a subject, without the most patient investigation; and, in the present state of your knowledge, I am compelled to omit the relation of several very important circumstances, to which I may, hereafter, direct your attention. When, for instance, you have become acquainted with

the elements of astronomy, I shall be able to show you that the gyration of the top depends upon exactly the same principles as the precession of the equinoxes. (15) I will now, if Mr. Twaddleton pleases, attend you to the *see-saw*, which I understand the gardener has constructed for your amusement."

The party accordingly walked to the grove, in which a plank had been placed across a wooden post; and upon which Tom and John had been riding for some time in the earlier part of the morning. The boys again mounted their new hobby; and, after amusing themselves for some minutes, Mr. Seymour desired them to stop, in order that Tom might explain the principle upon which the *see-saw* acted. Tom replied, that he was not aware of any principle which could apply to riding on a plank.

"Have I not often told you, my dear boy, that the principles of Natural Philosophy may be brought to bear on the most trivial acts of life? Listen, therefore, and you shall find that your present amusement teems with instruction. You are already well acquainted with the nature and operations of the centre of gravity; tell me,

therefore, whereabouts it lies in the plank upon which you are riding."

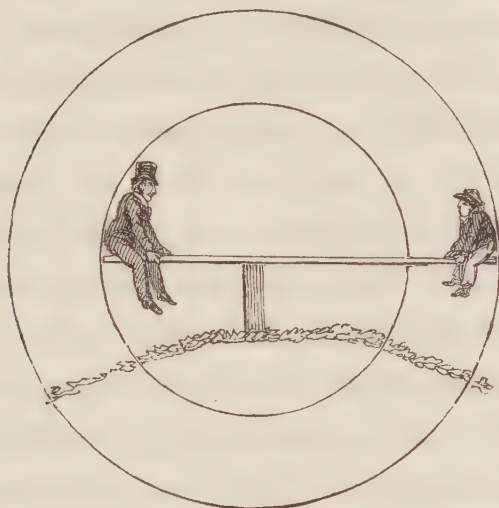
"I should think," replied Tom, "that in this instance, the centres of gravity and magnitude must coincide, or be very nearly in the same point."

"The centre of gravity must, as you say, be very nearly in the middle of the board; and if that be the case, you will allow that, supposing those who ride upon it are of equal weight, the plank must be supported in the centre, to make the two arms equal; but you and John are of unequal weight, so that you perceive the plank must be drawn a little farther over the prop to make the arms unequal; and John, who is the lightest, must be placed at the extremity of the largest arm. Thus arranged, you will exactly balance each other, and as each of you, on your descent, touches the ground with your feet, the re-action affords you a spring, which destroys the equilibrium, and enables you to oscillate in arcs about the centre of motion."

"Do we then describe the arcs of a circle as we ascend and descend?"

"Undoubtedly you must. Look at this diagram," said Mr. Seymour, "and you will see

at once that the plank can only move round its centre of motion ; for how could you rise, or



your brother fall perpendicularly in a straight line? You must, in rising, and he, in descending, describe arcs of your respective circles. It is equally evident that his velocity must be very superior to yours ; for, if you could swing quite round, you would each complete your respective circles in the same time."

" It would really appear so," said Tom ; " and I have myself observed, that the lighter person has the better ride, as he moves both farther and quicker, and I now understand the

reason of it; it is because being farther from the centre of motion he describes a larger arc."

"The greater velocity, with which your little brother moves, renders his momentum equal to yours. You have the most gravity, he the greatest velocity; so that, upon the whole, your momenta are equal: for you, no doubt, remember that momentum is weight multiplied into velocity.* You have here then a striking instance of mechanical advantage gained by opposing motion to matter, or velocity to weight; for I think you will readily admit, that without the aid of the plank, your little brother could never have raised you from the ground."

"That is clear enough," said Tom.

"Then the plank thus arranged," continued his father, "constitutes a *mechanical power* to which the name of *lever* has been given; it is not, however, my intention at present to enter into the history of these powers, of which there are no less than six; but on some future occasion I must direct your attention to their consideration." (6)

"We will now return to the lodge," said Mr.

* See page 118.

Seymour to the vicar; "let the children remain at their sports."

"I must away to the vicarage," replied Mr. Twaddleton; "for I expect to receive a visit from the major, and I should be grieved at being from home, when he does me the honour of a call."

"If you will return with me to the house, I will afterwards accompany you."

"Agreed," cried the vicar; and with this determination the two friends proceeded through the shrubbery, where they were met by Mrs. Seymour, who presented a note to her husband.

"What have we here?—a note, and sealed with a wafer!—I perceive it is from Mary Martin, Mr. Richdale's landlady."

Mr. Seymour then read as follows:—

"Honoured Sir,—My lodger, Mr. Richdale, set off before daylight for London, and so I thought it right to inform you that he cannot dine at the lodge. Poor man, he was in a terrible taking when he received the note that I suppose was to order him off. But it is altogether a very strange business, he has left his books and papers on the table; but I am sure

they are all safe for me, I have no curiosity about me; and so I remain,

“Yours at command,

“MARY MARTIN.”

“It is, indeed, a strange business,” said Mr. Seymour, as he concluded the above epistle. “A mystery hangs over that young man which is beyond my art to penetrate.”

Louisa at this moment joined the party, and on their arrival at the Botanical Horologe, they found that it was past two o'clock, for the *Arenaria Purpurea*, or *Purple Sandwort*, was closed, but as the *Calendula*, or *Field Marigold* was still open, they knew that it could not yet be three o'clock.

“Upon my word,” said the vicar, “I must leave you. This is the hour at which the major proposed to call upon me.”

“Promise then,” replied Mr. Seymour, “that, should the major disappoint your expectation, you will return and dine with us.”

“I will return in an hour, unless I am detained by my military friend.”

True to his appointment, did the vicar make his re-appearance at half-past three o'clock; and,

as he approached the children, who were awaiting his arrival, Louisa observed that he was carrying a canvass bag in his hand.

“What have you there?” asked Mr. Seymour. “A sack of sugar-plums?”

“No, no; spheres of larger diameter. Here,” said the vicar, as he opened his bag, “is a foot-ball for you, Tom; and here is a hand-ball for you, Louisa. He then presented each of the other children with a similar present, exclaiming —

“‘Nemo ex hoc numero mihi non donatus abibit.’* ”

as Virgil has it.”

“Perhaps,” said Mr. Seymour, “you will enhance the value of this favour, by giving us an antiquarian history of the ball?”

To this request the vicar readily assented, and proceeded as follows: —

“The Greeks appear to have played with four kinds of ball; viz. the *little ball*, the *great ball*, the *empty ball* (σφαίρα κενή), which was blown up with air, like our foot-ball, and the *leathern ball* (χωρυχόν), which was suspended from

* “Not one amongst you shall depart without a gift from me.” *Æn.* v. 305.

the ceiling, and stuffed with bran or sand, as those who tossed it were robust or delicate. The Romans," continued the vicar, " had also four kinds of *pilæ*, or balls. The *follis*, a large ball made of leather and blown up with air, like our foot-ball; the larger kinds of which were struck with the arm, the smaller ones, with the fist. Suetonius tells us that Augustus Cæsar greatly delighted in the amusement; and in truth it was a glorious sport, an exercise equally adapted for the young and old; or as Martial has it, —

“ ‘ *Folle decet pueros ludere, folle senes.*’ * ”

The second kind was termed *trigonalis*, which is conjectured to have been nearly the same as our tennis-ball. It derived its name from the position of the three persons who played with it; they were placed in a triangle, and alternately caught and tossed the ball, and he who first let it fall to the ground was the loser. The third kind of ball was the *paganica*, as being much used in country villages. Some authors state it to have been constructed of leather and stuffed with feathers, while others conjecture it to have

* Lib. xiv. epig. 43.

been a large kind of *follis*. The fourth was the *harpastum*; a small ball, so called because the gamesters endeavoured to snatch it from each other."

"It seems," observed Louisa, "to be a sport better adapted to boys than girls."

"In that supposition, you are quite mistaken," replied the vicar; "on the contrary, the hand-ball would seem to have been originally a female sport, for Homer has restricted the pastime to the princess and young maidens of Corcyra; at least, he has not mentioned its ever having been practised by the men.

" 'O'er the green mead, the sporting *virgins* play,
Their shining veils unbound; along the skies,
Toss'd and re-toss'd, the ball incessant flies.' " *

Mr. Seymour said that, as the vicar had satisfied them of the high antiquity of the ball, he hoped he would now afford them some information respecting its use in England.

"The game of hand-ball," said the vicar, "called by the French *palm-play*, because the exercise consisted originally in receiving the ball, and driving it back again with the *palm of the hand*, was formerly a favourite pastime

* Pope's *Odyssey*, lib. v.

among the youth of both sexes ; and in many parts of the kingdom it was customary for them to play at this game during the Easter holidays for tansy cakes. In ancient times, the mayor and aldermen of Newcastle used to go in state at the feasts of Easter and Whitsuntide, to a little mall of the town to witness this game. It was originally played with the naked hand ; then with a glove, which in some instances was lined ; afterwards, cords and catgut strings were bound upon the hand, to make the ball rebound more forcibly."

"That custom," observed Mr. Seymour, "doubtless, gave origin to the *racket*."

"It did," replied the vicar, "and the places where this game was played were called *tennis-courts*, and the game itself obtained the name of *tennis*, from the French word *tenez** (take it,

* This etymology has been disputed, and it has been said that the holding or keeping possession of the ball is no part of the game ; for, during the play, the ball is in continual motion, or passing from one to another. Others seek the etymology of the name, and the origin of the game, in a place in France called Tennois ; or, by a change of one letter, Sennois, in the district of Champagne, where balls were first made, and the game, as it is said, first introduced.

hold it), frequently used during the exercise. The pastime, I believe, was introduced amongst our ancestors about the year 1222, the sixth year of Henry III., by persons of superior rank and family, who erected courts or oblong edifices for the performance of the exercise."

"I long to hear something about foot-ball," exclaimed Tom.

"That is a pastime," said the vicar, "which was formerly in great vogue in England, but of late years it has fallen into disrepute. It derives its name, as you may suppose, from the circumstance of the ball being driven with the foot, in preference to the hand. When a match is made, two parties, equal in numbers, take the field, and stand between two goals, which are placed at the distance of eighty or a hundred yards from each other. The ball, which is commonly a blown bladder, cased with leather, is delivered in the midst of the ground, and the object of either party is to drive it through the goal of their opponents, by which the game is won. The abilities of the performers are best displayed in attacking and defending the goals, whence the pastime is more frequently called a *goal*, than a *game* at foot-ball.

In this attack and defence, the exercise becomes exceedingly violent; the players kick each other's shins without the least ceremony; and this occasioned James I. to speak of foot-ball as '*meeter for laming than making able the users thereof.*' "

" I believe," said Mr. Seymour, " that the ancient game of *goff* is still much practised in Scotland."

" It is," replied the vicar. " In the reign of Edward III. the Latin name *cambuca*, a crooked club, or staff, was applied to this pastime, because it was played with such an instrument. The bat was also styled a *bandy*, from its being bent; and hence the game itself is frequently called *bandy-ball*."

" And how is it played?" asked Tom.

" It is played on a smooth common, by driving forwards two small hard balls, with the *bandy* I have just described, into very distant holes in the ground, about a foot deep, and nine inches over; and the party, whose ball is driven into these holes with the fewest strokes, is the victor."

" But come," said Mr. Seymour, " it is high time to think of our dinner; the children must

require some refreshment. I am not, my dear vicar, one of those philosophers who believe that play was invented by the Lydians, as a remedy against hunger; nor do I subscribe to the opinion of the elder Scriblerus, that it was on such an account wisely contrived by Nature, that children who have the keenest appetites should, at the same time, be those who are most addicted to sport."



CHAP. X.

MISS KITTY RYLAND'S ADVENTURES IN LONDON. —
A SCENE BETWEEN A. B. AND X. Z. — THE SPIN-
STER'S EXTREME DISAPPOINTMENT AND CHAGRIN.
— THE SWING. — THE DOCTRINE OF OSCILLATION.
— GALILEO'S DISCOVERY. — THE PENDULUM. —
A CONTROVERSY BETWEEN THE VICAR AND THE
MAJOR. — MAJOR SNAPWELL PURCHASES OSTER-
LEY PARK. — CONCLUSION OF THE FIRST VOLUME.

As a week has now nearly elapsed, since the departure of Miss Kitty Ryland, the reader will doubtless be anxious to obtain some information respecting the plan and success of her operations; we will, therefore, by the aid of a little talismanic wand, with which *Mother Goose* has happily furnished every author, transport him, at once, to Bond Street, without the otherwise essential machinery of locomotion. We shall find our heroine snugly lodged in the little back parlour of Mrs. Tenterhook, the widow and successor of a fashionable glover, in whose house, it may be remembered, Miss Kitty thought it probable that she *might* have formerly seen the nephew of Major Snapwell; for, to use her own expression, her friend was “hand and glove” with all the beaux of Bond Street. On the morning after her arrival, she carefully composed a letter, with the signature A. B., and appointed an interview with X. Z. on the following day at one o’clock. Miss Kitty had informed Mrs. Tenterhook that she adopted the signature A. B., for *very particular reasons*, but, as she never dropped a hint as to the object of the proposed interview, it cannot be supposed

that she imparted the nature of those reasons, which had influenced her in so important a decision. The reader is, therefore, abandoned to his own conjectures; but, as we are always willing to assist his judgment on questions of difficulty, we shall, without hesitation, state it as our firm conviction, that one of the following motives had actuated her upon this occasion. She was, as the reader will probably remember, rather inclined to a superstitious belief in ominous words and things; she has, for instance, been known to be in a state of despondency for a week together, from throwing down the salt, or accidentally putting on the left before the right shoe. With this knowledge of her character, and having frequently heard her repeat the popular saying, that “*extremes are sure to come together,*” we cannot help thinking that the initials A. B. were selected on this very account, as being in opposition to the letters X. Z.; although some of our fair readers may probably prefer the more poetical explanation which we shall, in the next place, suggest for their consideration, *viz.* whether the aforesaid initials might not have been preferred as being most remote from X. Z., and

therefore beautifully expressive of that maiden reserve, which the delicacy of her situation rendered so particularly decorous?

The epistle having been despatched by a confidential messenger to Gray's Inn Coffee-house, the lady's spirits became more tranquil, and she was enabled to dedicate the remaining portion of the day to the purchasing of white ribands, and sundry other articles, which she thought it probable that she might hereafter require. With Mrs. Tenterhook she also came to a very satisfactory understanding, that lady having promised to provide her with any number of white kid gloves at the trade price. At length the morning dawned, and Miss Kitty, having passed a sleepless night, owing, as she said, to the unaccustomed noises of Bond Street, proceeded to her toilet, where she spent several hours, in consequence, doubtless, of that inferior accommodation which was afforded by the house of business in which she lodged. The hour of one arrived, and the appointment was faithfully observed. As an account of the interview may afford some amusement to our readers, and as, indeed, the relation of it is absolutely essential to the thread of our history,

we shall, with a delicacy and decorum which we trust were never even exceeded in a police report, proceed to describe its commencement, progress, and conclusion. Those of our readers, who have ever been placed in the anxious situation in which Miss Kitty found herself on this occasion, will scarcely expect us to describe the sighs, palpitations, and nervous tremours, which must ever precede so momentous an interview; we shall, therefore, at once, proceed to our drama without the usual ceremony of a prologue; although, before the curtain rises, the author, as stage-manager, feels it his duty to explain an irregularity which may possibly occur from the *mauvaise honte* of the principal performer, that of deferring the *Overture* until after the first scene.

“Ma’am, here’s a man, if you please, enquiring for a B— who’s just com’d from the country,” bawled the strapping maid of all-work, as she thrust a moiety of her dusty person into the little back parlour where Miss Kitty was sitting cosily with the cat.

“Enquiring for a B—!” exclaimed the sensitive spinster. “What unheard of insolence! Are these your manners of Bond Street, girl?”

Who is the foul-tongued varlet that thus ventures to violate all decency in the very heart of genuine politeness? I'll be bound, it is that saucy prig of the bandbox whom I '*cheepened*' at the riband shop yesterday."

"La!" cried the giggling maid, as she lashed the air with her dingy duster, to the no small hazard of Miss Kitty's white gown, "why, he says his name is X.Z."

"I beg the worthy gentleman ten thousand pardons; but the mistake is entirely your fault, Becky; such disgusting stupidity and ignorance I never before met with; why, don't you know your letters, child? He enquired for A. B., and you, forsooth, must pronounce it, as though it had been little *a*, with a bouncing B."

"I am sure I never said no such thing, as a bouncing B; but I knows what I knows; and that some folk are very stropulous, when other folk call upon them."

"Silence, thou impertinent slut — silence — and come in and shut the door; would you expose your vulgarity and ignorance to all the fashionables of Bond Street? Shut the door, I say. Now tell me, Becky," continued Miss

Kitty, in a greatly subdued tone, "what sort of a looking person is this Mr. X. Z.?"

"Why, as to that, he's well enough I suppose; a little crooked, and oldish or so."

"How old?" cried the impatient spinster, "forty? — five-and-forty? — fifty? — why, he surely is not above fifty, girl!"

"Well, who said he was? but I can't tell, and that's the truth on't; the shop is so plaguy dark, there's no seeing what's what."

"Well, Becky, where is the gentleman?"

"Why, where should he be, but in the shop. He said that how he wanted a pair of gloves, and that, while I let you know, he would fit them."

"White kid, I'll warrant it," said Miss Kitty.

"No, ma'am, that they wan't; for I heard him say, with my own ears, 'black silk, if you please.'"

"What refined delicacy! what charming sensibility!" mentally ejaculated Miss Kitty; and what a clever expedient, thought she, to disguise the object of our interview.—Thus is it ever with the human mind, when possessed by any one predominant idea; it distorts every

object to suit its own peculiar bias ; and whether it be black, or whether it be white, it soon discovers that it is by far the most appropriate of all the hues that could be imparted to it.

“ Well, Becky,” said the spinster, “ show the gentleman in — but stop a moment — not yet — presently, Becky — give me my smelling-bottle ; and do, pray, my good girl, pour me out a cupful of mint julap, for a very strange faintness has come over me. There — there — now you may go ; and say that A. B. will be most happy to receive X. Z.”

The interval between the departure of the servant-maid, and the entrance of the stranger, could not have exceeded five seconds in duration ; and yet, so industrious is human thought, that in this brief moment, what brilliant scenes did it conjure up, what schemes of happiness, and what arrangements for future action !

The door opened, and the stentorian voice of Becky bellowed forth, “ X. Z., if you please, ma’am.”

Miss Kitty instinctively retreated to the farther end of the diminutive apartment, and the stranger pausing at the door left ample room between them for the insertion of all the inter-

mediate letters from A. to Z.; provided, indeed, that they had not exceeded in size the usual proportion of a child's alphabet.

X.Z., for by those initials is he only yet known to the reader, was diminutive in stature, and his lower extremities having received an unfortunate bias in the nursery, might be said, like the feet of the curule chairs, to resemble the X, which he had chosen as his first representative letter; while his whole person, during the operation of an obsequious bow, with which he greeted our heroine, described a zig-zag, not unlike his second initial, or the concluding letter of the alphabet. His head had been liberally powdered, but the rebellious colour of his hair still blazed from beneath the surface, and imparted a tinge which might be compared to that of the red snow described by Captain Ross in his *Voyage of Discovery*. Nor was his countenance, perhaps, exactly that which Miss Kitty's imagination had depicted; but she had so often declared, that where the gem was of the first water it signified little whether it were set in gold or pinchbeck, that we do not, for a single moment, believe the first view of his person made the least unfavourable impression. Such,

however, as the stranger was, we are bound to describe him, and the reader shall accordingly receive as faithful a portrait as we are capable of producing. His features, like the factions of a distracted city, appeared as if mutually distrustful and suspicious of each other ; his mouth nearly extended from ear to ear, and whenever its capacious portals opened, it was really ludicrous to observe with what haste, and considering its size, with what agility, the nose retreated upwards, as if terrified by the dingy sentinels that grinned within the threshold ; nor did his large grey eyes display a greater share of confidence, for they seemed as though straining themselves from their very sockets, in order to keep a good look out, and awe, if necessary, the herald tongue into silence.

“ I believe,” said the gentleman, “ I have the honour of addressing A. B. ;” his eyes displaying, as he spoke, such an obliquity, as to render it doubtful whether they were directed to Miss Kitty, or to the silver buckles which decorated his shoes.

“ And you are, doubtless, X. Z.,” replied the lady.

“ The same, madam ; if it therefore meets

your wishes, we will, without ceremony, proceed to the immediate object of our interview."

Miss Kitty dropped a low courtesy ; and the gentleman offering her a chair, upon which she immediately deposited herself, took his seat at a respectful distance.

" Before I proceed to the consideration of those views which I have long entertained upon the subject in question, allow me, dear madam, to apologise for the apparently singular, and, in some respects, objectionable channel of communication which I have been induced to adopt."

" If you allude to the advertisement, say no more upon that subject ; as to apology, it is out of the question ; nothing like humiliation should take place between persons who are mutually interested in each other's good opinion."

" Be assured, dear madam, that if I am so happy as to gain your confidence, it shall be the study of my life to preserve it."

" I doubt it not, sir ; your open and candid avowal is a sufficient guarantee for your honourable motives."

" I hate professions, madam, but thus much, as we are strangers, I may be allowed to state,

that in all our transactions, every consideration will be given to your own advantage and security."

"Nay, dearest sir, I should despise myself for accepting any benefit of which you were not an equal partner."

"I thank you for your liberality. Some little reward it is of course natural for me to expect; but as to an equal participation in the benefit, that is really quite out of the question. My success, as a solicitor, has enabled me to scrape together somewhere between forty and fifty thousand pounds, so you will readily conceive, that my object cannot be entirely selfish. Poverty may, perhaps, be pleaded in extenuation of certain actions, which cannot admit of any palliation in the wealthy."

This declaration produced a most extraordinary influence upon Miss Kitty; if she had before been condescending and pliant, she now became obsequious.

"Name your own terms, and I am sure I shall be happy to comply with them; my fortune, dearest sir, is extremely limited. I have an income of about three hundred a year arising from stock in the three per cents."

“ Well, madam, and let me tell you, that a very pretty little property it is, and I have no doubt, but we shall be able to make it yield at least three times that interest in a very short time. I propose to apply the principal for the benefit of children, in whose welfare I take great interest.”

“ Future children,” said Miss Kitty, with a smile; “ I can have no objection.”

“ No, no, madam; for children, poor things, who are much distressed on account of the state of certain property that is at present not available; but the security is unexceptionable. I have, only this morning,” continued the gentleman, “ seen a lady upon the very subject for which we have now met; and I believe the affair is settled; she appears quite willing.”

“ My dear sir, but surely — surely you would not — you would not — I have not declined, I am most willing to accede to your proposition.”

“ I rejoice to hear it for your sake, but there can be no objection to my immediately concluding a similar arrangement with the lady to whom I allude.”

“ What, two at once!”

“ Two at once; why, bless me, madam, it is

my object to gain the consent of thirty, if possible."

"Of thirty!!!—oh the Turk—the deceiver!" ejaculated Miss Kitty, as she fell back in her chair, so violently agitated as to alarm her companion.

"Why, my dear madam—my dear madam—good gracious, she is in hysterics—what am I to do? Here, Betty, Betty—help! help!"

"La! la! what can the matter be?" cried Becky, as she popped in her head at the door. "Grace defend us! why if Miss Ryland ben't in the *sterricks*!"

So saying, the humane girl rushed towards the afflicted damsel, and by the flapping of her duster raised a wind that would have worked a mill; but, unluckily for Miss Kitty's face, not only the air, but the dust, was set in motion by the operation, and the pallor of her countenance was exchanged for the hue of soot. The bustle soon brought farther assistance; Mrs. Tenterhook, followed by two of her customers, besides the shop-boy, entered the apartment. There was an immediate and simultaneous cry for fresh air.

"Open the window," exclaimed a stout gentleman, as he raised his hand, which had the

moment before been invested by a new beaver glove, but which, in the hurry of the moment, had not been separated from its dangling partner; “open the window, or, by all the saints in the calendar, we shall suffer the fate of the prisoners in the black hole. See, see, the poor lady is quite black in the face.”

Miss Kitty, however, by the aid of her mint julap, and sundry sniffs at her blue smelling-bottle, had, by this time, nearly recovered; and, having thanked her kind friends for their prompt assistance, she relieved their anxiety, and averted an impending torrent of questions, by assuring them that it was one of those attacks to which she was always subject in hot weather, and had, doubtless, been brought on by the fatigue of her journey.”

“No, no,” said Mrs. Tenterhook, “I told you how it would be, if you persevered in eating them black-puddings, without winegar, for supper; besides the punch — only think of the punch — three large rummers!”

“Oh, fie upon you!” exclaimed Miss Kitty; “for goodness’ sake, my dear Mrs. Tenterhook; you know I would not drink a thimbleful of spirits for all the gloves in your repository.

What a singular opinion must this gentleman form of my habits, for he cannot possibly understand your joking way: but, pray leave us for the present. I am perfectly well again, and feel fully prepared to proceed with the business in which we were engaged."

Mrs. Tenterhook, who was never backward in taking a hint, gave a significant nod to the auxiliary troops, whom she had introduced, and retired from the room, having carefully closed the door after her.

"And can you wonder at my distress?" sighed the dingy-faced maiden, as soon as she perceived that she was left to a secure *tête-a-tête* with her faithless friend, "to be so treated; the finest feelings of sensibility wounded! my female delicacy shocked! and every sense of propriety outraged!"

"My dear madam, may I entreat you to be more explicit; I declare, upon the honour of a solicitor, I have not the most remote idea of the nature of my offence. My language, as I thought, was peculiarly guarded and respectful, and what may have been the expression which you have thus construed into an insult, I am at a loss to conjecture."

“ Insult ! say cruelty, barbarity, injustice ! ” replied the spinster : “ was ever woman so treated before ! I am not insensible to the delicacy of my situation, nor to the dangers which attend it, but I should despise myself were I to dissemble my feelings. You advertised for a domestic partner to halve your misfortunes, and double your pleasures ; I answered the invitation, and I had hoped — but no matter — I retire, sir ; and may you meet with one who is better calculated to ac — com — p — lish ” — here the lady’s sobs interrupted the conclusion of her affecting appeal.

“ A partner for life ! — a wife ! ! — I advertise for a rib ! — Ha, ha, he ; — excellent ! — Why, zounds, madam, I advertised for a client, not a wife. I practise as a solicitor in the court of Plutus, not in that of Cupid.”

“ Was it then really for a *client* that you advertised ? ” exclaimed Miss Kitty.

“ Why, to be sure ; did not the advertisement distinctly state, that any maiden lady, of competent fortune, might, by application to X. Z., hear something greatly to her advantage ? And, pray, let me ask you, whether it would not be to the advantage of such a person, to have

her income trebled, and that without the least risk or trouble, and with a comfortable *bonus* upon the conclusion of the arrangement?"

"I see it all too plainly," murmured the abashed spinster.

"And now, madam," continued the gentleman, "it is my turn to complain; for let me tell you, that I am the person really aggrieved in this transaction. You have, under false pretences, induced me to violate a confidential trust; you have, as it were, extorted from me the announcement of a plan which should never have been divulged, except to the contracting parties. I have been too long hackneyed in the ways of the world not to discover the motives which have influenced you, throughout the whole of the proceeding. They were grounded, madam, on curiosity. You read the advertisement, and became inquisitive as to its object. Never, in the whole course of my life, and I speak from no slight experience, did I find a woman in a scrape, after the age of forty, that might not be traced to that germ of evils, curiosity. But, hear me; there is one way in which you can easily extricate yourself from the web, which you have so ingeniously woven

for your own destruction. My object is to raise a large sum of money, upon a profitable scheme of annuities; contribute a couple of thousands to the plan, and the events which have just occurred shall be buried in oblivion; if you refuse, I will take measures that may prevent others in my profession being duped in a similar manner. But think not that I would take an unfair advantage of your distressing situation: here is my card, and as we are strangers to each other, inquire into my character; and should you hear any thing that may reasonably shake your confidence in my honour, most willingly will I exonerate you; but, if otherwise, I shall expect your compliance upon the terms I have just specified." So saying, the gentleman placed his card in the trembling hand of our spinster, and making his zig-zag bow, the ex-suitor took his departure; while the lady hastened in no milkiness of mood to her toilet, in order to revise her *title-page*, and to cleanse it from the discoloration which it had received from the foul breath of Becky's duster.

It is now high time that we also should quit this scene; and our readers will, no doubt,

agree with us in thinking, that Bond Street in August may be exchanged for Overton without regret ; with their permission, therefore, we shall once again wave our magic wand, and convey them back to the grounds of Mr. Seymour's mansion.

The children had been amusing themselves for some time with a new swing that had been lately erected for them by the gardener.

" Papa," said Tom, " as you appear capable of extracting philosophical knowledge out of all our amusements, I should not be much surprised if even the swing should be made subservient to some purpose of instruction."

" Undoubtedly it may," replied Mr. Seymour, " for it has an immediate connection with the doctrine of *oscillation*, or the theory of the pendulum. The vibrations of the swing, like those of the pendulum, are produced by its effort to fall, from the force of gravity, and its power of ascending through an arc similar and opposite to that through which it has descended, from the momentum acquired during its descent."

" Like the bandilor, I suppose," said Louisa.

“ Exactly, my dear, that is a very good comparison ; for as the bandilor, having descended along the string by its gravity, acquires such a momentum as to enable it to ascend the same string, and thus, as it were, to wind itself up ; so does the pendulum or swing, during its descent, acquire a force that carries it up in an opposite arc to an equal height as that from which it had fallen. But tell me, Tom, whether you have not discovered that the motion of your new swing differs from that which you experienced in your former one ? ”

“ The ropes of our present swing are so much longer than those which we formerly used, that the motion is much pleasanter. ”

“ Is that all ? ” said Mr. Seymour. “ Have you not observed that you also swing much slower ? ”

“ I have certainly noticed that, ” said Tom.

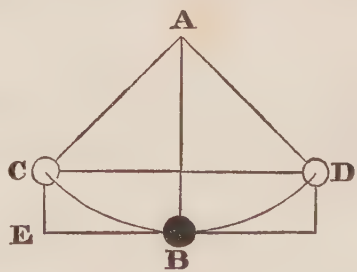
“ It is a law which I am desirous of impressing upon your memory, that the shorter the pendulum, or swing, the quicker are its motions, and *vice versa* ; indeed, there is an established proportion between the velocity and the length, which I shall, hereafter, endeavour to explain to you. Galileo, the celebrated philosopher,

and mathematician to the Duke of Florence, accordingly proposed a method of ascertaining the height of the arched ceiling of a church by the vibrations of a lamp suspended from it. The solution of the problem was founded on the law to which I have just alluded, viz. that *the squares of the times of the vibrations are as the lengths* ; so that a pendulous body, four times the length of another, performs vibrations which last twice as long. Now it is known that, in the latitude of London, a pendulum, if 39 inches and two tenths in length, will vibrate seconds, or make 60 swings in a minute ; by observing, therefore, how much the pendulous body deviates from this standard, we may, by the application of the above rule, find its length ; if the distance from the bottom of the lamp to the pavement be then measured, which may be done by means of a stick, and added to the former result, the sum will give the height of the arch above the pavement : but I will show you the experiment the next time we go into Overton church ; the vicar can tell us the exact height of the roof, and I will try how nearly I can approach the truth, by observing with a

stop-watch how many seconds one vibration of the chandelier continues."

"But, papa, why surely the duration of its vibration must depend upon the force which you may happen to give to the chandelier?"

"Not in the least; and this brings us at once to the consideration of the most curious and important fact in the history of the pendulum, and for a knowledge of which, we are also indebted to Galileo.* It is termed its *isochronous*† property, or that by which all its vibrations, whether great or small, are performed in exactly the same period of time; but that you may be better able to comprehend this subject attend to the diagram which I have prepared for your instruction. Suppose that the swing or pendulum A B be raised to c, it will, in effect, be raised the perpendicular height E C, and in falling will describe the arc C B; and, in



* This discovery was published at Paris, in a treatise called "*L'Usage du Cadran ou de l'Horloge Physique Universelle*," in the year 1639; from which may be dated the invention of the pendulum.

† Compounded of the Greek words *ισος* equal, and *χρονος* time.

the point B, it will have that velocity which is acquired by descending through c B, or by a body falling freely through the perpendicular c E. This velocity will be sufficient to cause it to ascend through an equal arc B D, to the same height from whence it fell at c; and since the times of ascent and descent are equal, it will describe both these arcs in exactly the same space of time. Having lost all its motion at D, it will again begin to descend by its own gravity; and in the lowest point B it will acquire the same velocity as before, which will cause it to re-ascend to c; and thus, by ascending and descending, it will perform continual vibrations in the circumference c B D; and, were it not for the resistance of the air, and the friction at the centre of motion A, the vibrations would never cease: but from these obstructions, though small, it happens, that the velocity of the mass of matter at B is a little diminished in every vibration; and consequently it does not return precisely to the same points c or D, but the arcs described continually become shorter and shorter, till at length they grow insensible; and yet the very same time is required for the performance of the shorter as

the longer arcs ; for, although in the one case the body passes over less space, still its velocity is proportionally decreased. You perceive, then, that in an attempt to ascertain the height of a ceiling by the vibrations of the chandelier, the extent of its swing cannot alter the time which may be required for its completion. And, if you will place your little brother in the swing, you will perceive that he will return to your hand, in nearly the same space of time, whether he describes a large or small arc ; although this experiment must be considered as extremely rude, since there are many disturbing causes for which the theory cannot possibly make any allowance. I must, moreover, warn you that where the arc described is very considerable, the difference in the time will be greater ; for, in order to ensure this property of vibrating through unequal arcs in equal times, it is necessary that the path of the body should describe a peculiar curve, called a cycloid (16), and not the segment of a circle ; at present, however, it is not possible for us to enter into this difficult branch of science, although I trust that at some future period, I shall be justified in an attempt to explain it."

Mr. Seymour, having concluded the above lesson, was about to return to the Lodge, in company with Mr. Twaddleton, when Major Snapwell approached the party.

“Your most obedient, Mr. Seymour; *Salve, salve*, vicar,” said the gallant major: “and so, Mr. Twaddleton, it appears that you were alarmed at the prospect of another *tête-à-tête*, and have sought refuge in flight. You, doubtless, agree with Jack Falstaff, in thinking that ‘discretion is the better part of valour.’”

“You do me injustice,” replied the vicar: “had I been aware of your intention of calling at the vicarage, be assured that I should not have left my *penates* without protection.”

“You need not fear me,” said the major. “I hereby promise, never again to question the antiquity of your rarities, nor the rarity of your antiquities. You must know, my dear Mr. Seymour,” continued the major, “that I have offended your worthy friend; and, I fear, beyond the hope of forgiveness.”

“Offended me!” exclaimed the vicar: “oh no — no, indeed; a difference of opinion on an antiquarian subject may excite my regret, and, in some cases, awaken my pity; but, believe me,

major, it can never occasion any feeling like anger : that would be to visit the folly of others upon myself."

"What is the subject of your difference, gentlemen?" asked Mr. Seymour.

"The evidences of druidical rites, as deducible from certain cavities to be found in granitic rocks, and which have received the appellation of *rock basins*," replied the major.

"And of which," exclaimed Mr. Twaddleton, "I have a most unquestionable specimen, collected by no less a geologist than the curator of the cabinet at Penzance, from that ancient metropolis of the druids, *Carn-breh hill*."

"I admit," said the major, "that I never before saw so perfect a specimen ; it is as spheroidal internally, as if it had been actually shaped by a turning-lathe."

"And yet, in spite of such evidence," replied the vicar, "you question its sacred origin, and deny its ever having been used as a pool of lustration."

Mr. Seymour here interposed. "Upon a subject of purely historical difficulty, I might feel diffident in offering myself as an umpire between such learned antiquaries ; but, as the

origin of 'rock basins' involves a geological question, I will venture to deliver an opinion. Depend upon it, vicar, that you are maintaining a position that cannot be defended; these uncouth cavities, together with all the fancied statuary of Borlase, (17.) have never been shaped by any chisel but the tooth of time, nor have any artists, but the elements, been engaged in their formation."

"What say you to that, vicar?" triumphantly exclaimed the major.

"Oh, impiety, impiety!" cried the vicar;—

'Hostis habet muros, ruit alto a culmine Troja,'

as Maro has it. That such glorious monuments, which have so long braved the tempests, should fall under the hammer of these Philistines. Geology, Mr. Seymour, is infidelity in masquerade; remember the mites in the Cheshire cheese, Mr. Seymour, 'consider their ways and be wise.'"

"Philistines, as we are, in your opinion," replied his opponent, "our forges have served to sharpen your weapons against the attacks of infidelity."

“Come, come, gentlemen,” said the major, “the continuance of this discussion can neither amuse nor instruct us. I have, however, a subject for your consideration, which, I flatter myself, may possess some interest to all parties.”

“Let us hear it.”

“Well do you know,” continued the major, “that, like the dove sent out of the ark, I have been long wandering in quest of some resting place, and I have, at length, found a perch upon which I may roost in peace. You have frequently heard me express a desire to spend the few short years that may yet remain to me, amidst the rural shades of Overton. I yesterday learnt that Sir Thomas Sotherby is most desirous of disposing of Osterley Park, and offers many advantages to any one who will take it off his hands. I have both the inclination and the means to become its possessor.”

“It is perfectly true,” said the vicar, “that Sir Thomas is willing to make a considerable sacrifice, in order to obtain an immediate purchaser. The health of Her Ladyship is in so precarious a state, that her physicians have ordered her without delay, to Madeira.”

“ Then what say you, my excellent friends ? Have you, Mr. Seymour, any objection at receiving an old soldier as your neighbour ; and you, my worthy vicar, will the society of an unbeliever in rock idols be wholly insupportable ? ”

“ We shall be delighted,” answered the two friends.

“ No one in the neighbourhood,” observed Mr. Seymour, “ will miss Sir Thomas, but the doctor and the foxes ; the one will lose a profitable friend, the other, a relentless enemy.”

“ True,” said the vicar, “ ‘ *gaudet equis et canibus,*’ major.”

On the following morning, Mr. Seymour and Major Snapwell quitted Overton, for the purpose of making such preliminary arrangements as the purchase of an estate must necessarily require. It is not our intention to accompany them ; nor shall we travel over the plains of parchment, nor wade through the rivers of ink, which separate the confines of verbal agreement and legal possession ; but, claiming the prerogative of authors, we shall dip our wing in the cup of inspiration, and by a single flourish of our feathered talisman, at once put the major

in the undisturbed possession of his newly purchased mansion, and instal him in a comfortable elbow-chair, surrounded by all the luxuries of polished life.

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